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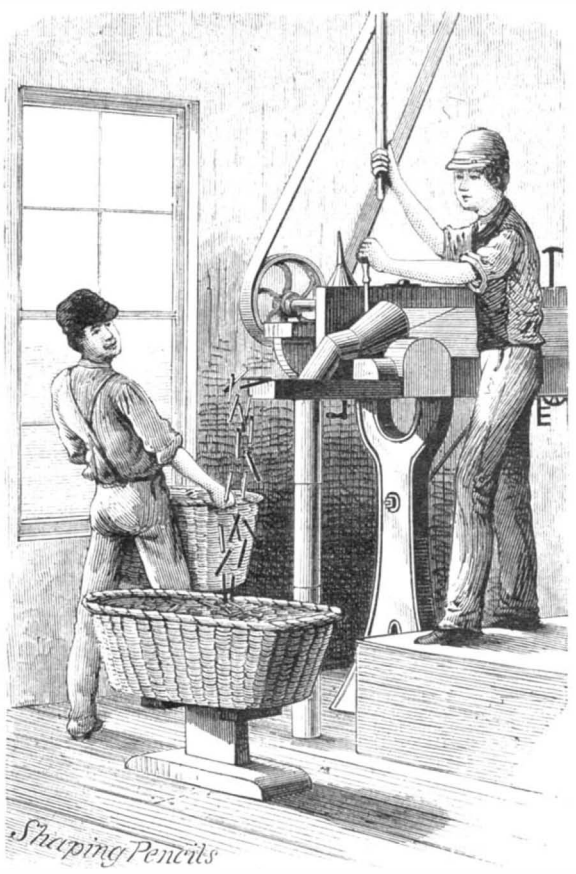
The Adulteration of Soft Soap.

The *Manufacturers' Review* translates from the French of M. Emile Picard the following note on the adulteration of soft soaps:

"One hundred parts of fatty matter, combined with soda or potash, yield 230 to 235 parts of pure soft soap, containing 33·14 per cent of water. When certain adulterants are added in quantities too small to affect the appearance of the soap, 100 parts of grease will yield 320 to 340 parts of what would be a good commercial article, containing 33 to 38 per cent of water. The same quantity of grease can be made to produce 380 parts of soap, containing as much as 52 per cent of water. The adulterants generally used are clay, resin, fecula, and silicate of soda. All are added to increase the yield of soap, and the proportion of water it can contain. Clay is the most harmless of these adulterants. It is partly dissolved by the alkali, but makes the soap opaque, and is easily detected by its insolubility in water. It increases the amount of water required to bring the soap to the proper consistence, but is not otherwise harmful. It is less and less employed every day. Resin combines with alkali, but the resulting compound 'possesses none of the emollient qualities of fats.' It retains large quantities of water, but alters the emollient and detergent power of the soap, and makes it more caustic and corrosive. Soaps adulterated with resin only are clear, brilliant and transparent; more soluble in water than pure soap. They nearly always retain a slight odor of resin which is most noticeable when the soap is warmed. Their color is often redder than usual. They attack the skin, and make linen yellow. Fecula is very harmful, especially when combined with silicate of soda. It is generally employed with three or four times its weight of lye, water, or silicate of soda. Soap made with it contains an excess of alkali, and a very large quantity of water. It is more or less opaque, as the proportion of starch is large or small; it is easily soluble in water; it is much affected by changes of temperature; and its detergent power is much lessened by the large proportion of water it contains. The latter fault is partly concealed by making it excessively alkaline; it is then corrosive, and attacks and destroys the skin, coloring matters, and woolen and silken goods. Analysis reveals the presence of the decomposition products of the latter in the water in which they have been washed. Silicate of soda with fecula is far the most injurious adulterant of soap, and it is also the one most usually employed.



Almost all commercial soaps contain it. Silicate of soda in small quantity does not alter the appearance of the soap; but it is decomposed when used, and silica is deposited in the fiber of the flax or cotton, and cannot be removed, rapidly destroying the tissues. Silk and wool are also attacked, and made more liable to be destroyed by alkalies. Water in which silk and wool have been washed with this soap contains considerable quantities of sulphur and ammonia resulting from the decomposition of the material. According to Dr. Vohl, linen and cotton cloths thus treated look, under the microscope, like worn fabrics—the fiber destroyed and the surface covered with a nap. Franklin said good bargains are sometimes ruinous. This is particularly true of soaps. Low-priced samples are never cheap; a larger quantity must be used to cleanse an equal amount, and fabrics are far more rapidly destroyed."

AMERICAN INDUSTRIES.—No. 2.

BY HAMILTON S. WICKS.

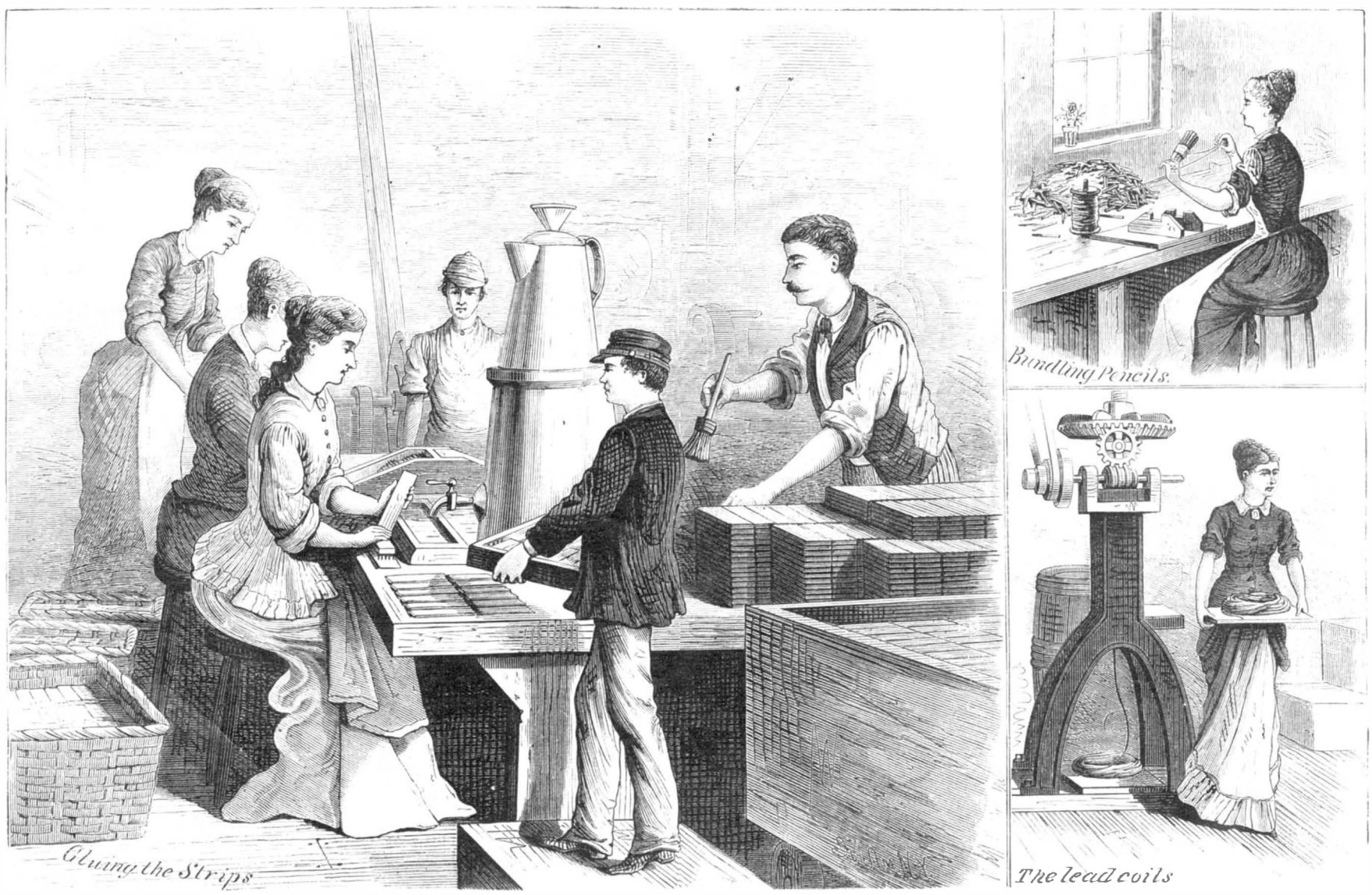
THE UTILIZATION OF GRAPHITE.

The works of the Dixon Crucible Co., at Jersey City, are interesting and curious. Established something more than half a century ago, the company has had a long and successful career, never falling behind in the march of improvement, but always prompt to adopt new methods for improving the products of industry and cheapening production.

The late Mr. Joseph Dixon was the originator of the present method of making crucibles from foliated graphite, and the establishment is the oldest and largest in the world of its kind.

Graphite, or what is commonly called plumbago or black lead, has long been known to possess wonderful properties, but the Dixon Company has been mainly instrumental in familiarizing the public with its great value in the mechanic arts. It was also the first to prepare the mineral in salable form for special uses. Resisting all acids and alkalies, and passing almost unhurt through a fire that will melt nickel, graphite is destined to act a prominent part in the industries of the world. It is the softest of all known minerals, a good

[*Continued on page* 34.]



THE MANUFACTURE OF LEAD PENCILS.

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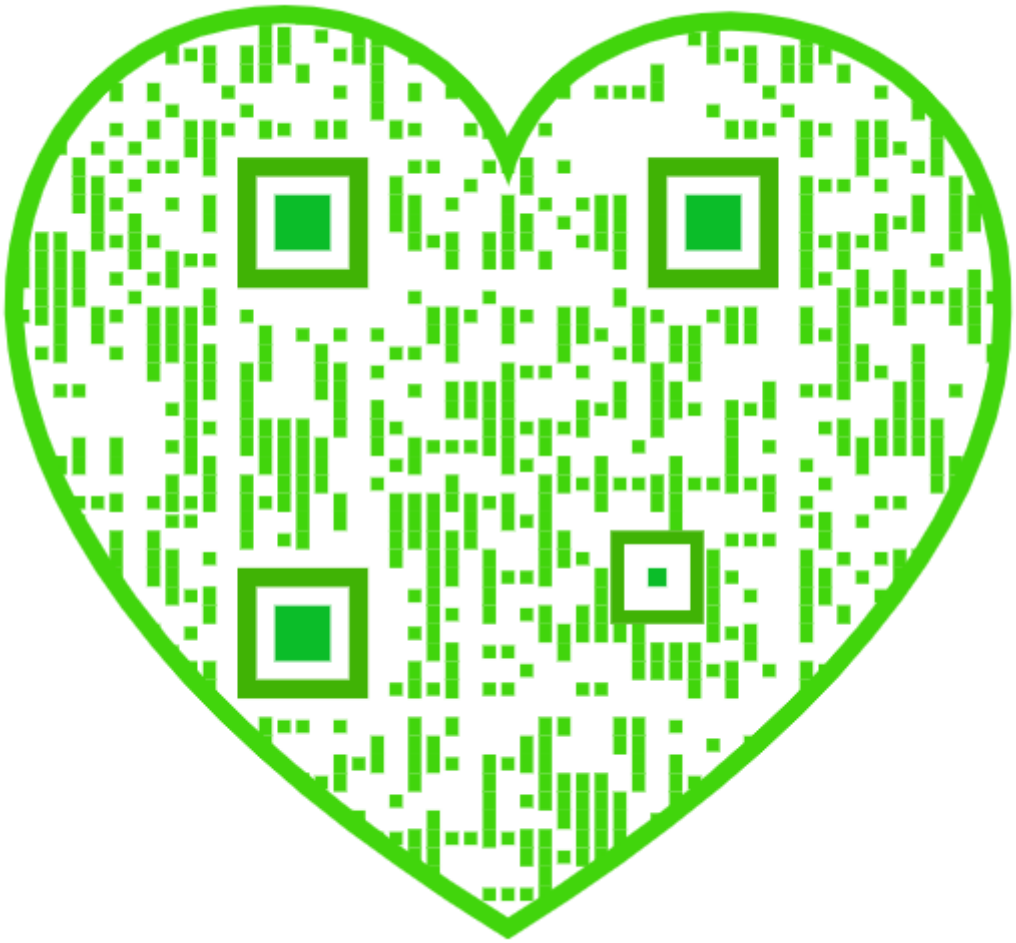

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NEW YORK, SATURDAY, JANUARY 18, 1879.

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IV. ELECTRICITY, LIGHT, HEAT, ETC.—Galvanic Batteries. No. III. By GEO. M. HOPKINS. Grove, Bunsen, Chromic acid or carbon, Fuller, and Marie Davy quicksilver batteries. Grove's gas battery. Byrne's, Plante's secondary, Clamond's thermo-electric, Hare's calorimeter, Trouve's new moist, and new form of Leclanche battery. These batteries are illustrated with 22 figures, and described at length, with directions for keeping in order, making carbons, care of carbons and porous cups, amalgamating the zinc, and making simple home-made batteries, with explanation of the terms, volt, weber, and ohm.

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The British Army in Afghanistan. The Military Elephants. A British Elephant Battery. Mouth of the Khyber Pass. 3 illustrations.—The Development of the Garpike.

OVER-DENSITY OF POPULATION IN CITIES.

The great and growing question as to the dangers, both to life and health, that result from an overcrowding of the population in large cities, has lately received a new treatment at the hands of the learned Dr. Parr, by the labors of whom the subject has been reduced to a science of almost mathematical exactness. In a paper entitled "Density or Proximity of Population, its Advantages and Disadvantages," recently presented to the Congress at Cheltenham, England, by this excellent authority, the statistics shown are somewhat startling, and put forth in such a way as to prove exceedingly interesting and instructive. Dr. Parr's principle is this "Observe the effects of the population-density; as a rule, the greater this density the shorter the duration of life; and this life-duration is seen to follow a ratio appreciable by simple arithmetic."

That man by his very nature is gregarious in his habits, and that, following the dictates of his nature, it is his wont to congregate in dense communities, is a fact so well known, and one that has been so often commented upon, as to appear trite in its repetition. We cannot, perhaps, expect to accomplish much in the way of changing his habits in this respect by moral suasion, the best we can do being to exhibit the results that modern science has arrived at in its investigations of the subject of overcrowding, not so much to the sufferers themselves from this state of things, as to the authorities whom they have elected to look after their welfare. The gist of the matter is given by Dr. Parr in the following words: "The nearer people live to each other the shorter their lives are," and the relations of this proximity to the duration of life are ascertained to be as follows:

"In round numbers, where we stand on an average 400 feet off from each other, we live on an average 50 years; where we are 300 feet off, we live 40 years; where we come within 60 feet of each other, we live but 30 years; and where we are but 20 feet off, we live but 25 years. It does not seem likely that by extending our interspace beyond the 400 feet we could prolong the average of life beyond 50 years; but it is very clear that if we contract the interspace beyond the limit of 20 feet we must rapidly reduce the mean of 25 years to 20, to 15, to 10, and before long, so to speak, to nothing. That is to say, there is a certain population-density with which, in the ordinary circumstances attending such a condition, human life could not be sustained at all; and from this melancholy zero there rises a scale of progression, obeying, of course, a recondite, but intelligible mathematical law, whereby we may measure off in a moment, according to the number of lives per acre, the number of years of life." Again, from Dr. Parr's actual figures we learn that "during the decennial period from 1861 to 1870 inclusive, the death-rate of certain of the most favorably situated districts of England, taken at per 1,000 of the population, proved to be 17 per annum, 16, and even so low as 15; whereas in certain other places it stood at 31, 33, and even 39 per 1,000 per annum. He then tells us that in those cases where 16 died in 1,000, each individual had to himself, on an average, 4 acres: where 15 died, each had 3 acres; whereas where 31 died, each had only one tenth part of an acre on an average; and where 39 died, each had only one one-hundredth part of an acre. The writer then goes on to show that, as regards the intermediate cases, the regularity of the rule is sufficiently precise." It further appears that the densest and most unwholesome of the districts in England is Liverpool, where a square mile holds no less than 63,823 human beings—an average of about one hundredth of an acre to each, or equivalent to a space of 12 by 12 feet. Thus it may be readily seen that if the men, women, and children of the lower order were to be placed on a surface of level country, each person being 12 feet from the next, and if the dirt, destitution, intemperance, and disease, coupled, of course, with the toil of this class, were conditions present in full force, 39 out of 1,000, or say 1 out of 25, must die annually. In other words, the average duration of human life must be as low as 25 years.

Such are some of the more important of the interesting facts given us by Dr. Parr in his valuable paper. The *Architect*, to which we are indebted for an abstract of these conclusions, remarks very truly that "no doubt the local circumstances of any particular community must always exercise a considerable influence on the death rate. It is scarcely necessary to say that it is not so much the crowd that kills, as it is the conditions under which the crowd accumulates; the conditions of soil and climate, of the contamination of air and water, of the disposal of refuse, of food supply, of the consumption of strong drinks, and of social character and habits in various ways, whether in labor or in idleness." While there is no doubt that such conditions as these exercise a large influence on mortality in large cities, there is also no doubt that the death rates in such communities are pretty certain indices of the perfection or imperfection of municipal arrangements in regard to sanitary matters.

Without pretending to state the cause, we may call attention, in connection with this subject, to the following fact: From the figures lately published by the German Imperial Statistic Office, giving the mortality per 1,000 inhabitants in the chief cities of the world, we learn that the death rate in the city of New York is about one third greater than that of London, and a fraction greater than that of Liverpool, which, as Dr. Parr has shown, is the most unfavorable district in England.

PATENTS IN NEW SOUTH WALES.

A bill to amend the laws relating to patents has been introduced in the Parliament of New South Wales. It provides for the establishment of a patent office, the appointment of a "Patents Officer," and the issuing of patents for inventions, and the publication of the patent specifications. Any person may obtain a patent for his invention, giving him an exclusive property therein, provided the invention has not been in public use in New South Wales for more than one year, or has not been patented in any other country more than one year. But if any one in New South Wales shall have begun to manufacture an article before the patent is granted, such person may continue to manufacture and sell such article notwithstanding the patent. The life of a patent is to be five, ten, or fifteen years, at the option of the patentee, the respective fees being $25, $50, and $75. The Government retains the privilege of using any patented invention on paying to the patentee such sum as the Patents Officer may decide to be a reasonable compensation therefor. Patents are assignable, wholly or in part, the assignment to be registered in the Patent Office. In case of infringements, the Supreme Court adjudges damages and costs.

SUN SPOTS AND COMMERCIAL CRISES.

To the numerous explanations that have hitherto been given by various writers on commercial topics, to account for the present depressed state of trade, there has recently been added another—this time from the pen of Prof. W. Stanley Jevons, who, in a late number of *Nature*, treats the matter at some length from a scientific standpoint.

The fact has long attracted attention that commercial crises, like the one through which we are passing, are marked by a certain periodicity in their occurrence, and they have been associated, not unreasonably, to a certain extent with a deficiency of crops, and such deficiencies again have in recent years been supposed to be in some way connected with the "sun spot period."

Professor Jevons, in his present paper, endeavors to establish a direct relation between the latter periods and times of trade depression; and, although his studies have not as yet allowed him to fix the exact nature of the connection, the data that he furnishes exhibit at least some curious coincidences. After some preliminary accounts of what has been done in this field of research, both by himself and others, in former years, Professor Jevons says: "It is impossible in this place to state properly the facts which I possess; I can only briefly mention what I hope to establish by future more thorough inquiry. . . . Deferring, however, for the present, any minuter inquiry, I permit myself to assume that there were, about the years 1742 and 1752, fluctuations of trade which connect the undoubted decennial series of 1711, 1721, and 1732 with that commencing again in the most unquestionable manner in 1763. Thus the whole series of decennial crises may be stated as follows: 1701 (?), 1711, 1721, 1731–32, 1742 (?), 1752 (?), 1763, 1772–3, 1783, 1793, 1804–5 (?), 1815, 1825, 1836–9 (1837 in the United States), 1847, 1857, 1866, 1878. A series of this sort is not, like a chain, as weak as its weakest part; on the contrary, the strong parts add strength to the weak parts. In spite, therefore, of the doubtful existence of some of the crises, as marked in the list, I can entertain no doubt whatever that the principal commercial crises do fall into a series having an average period of about 10·446 years. Moreover, the almost perfect coincidence of this period with Mr. J. A. Broun's estimate of the sun spot period—10·45 years—is by itself strong evidence that the phenomena are casually connected."

Hyde, Clarke, Wilson, and Danson all argued, 30 or 40 years ago, that commercial fluctuations must be governed by physical causes; but the difficulty that has beset the theory is that hitherto no one has been able to detect a clear periodic variation in the price of corn. Sir William Herschel endeavored to do this at the beginning of the present century in his inquiry as to the economic effects of the sun spots: but his facts are too meager to justify any certain inference. Professor Jevons confesses that as yet his own inquiries have been equally without result on this point. "The fact is," he says, "I believe that cereal crops, as grown and gathered in Europe, depend for their success upon very complicated conditions, so that the solar influence is disguised. But it does not follow that other crops in other latitudes may not manifest the decennial period. Dr. Schuster has already pointed out in *Nature* a coincidence between good vintages and minima of sun spots, which can hardly be due to accident. "Now, if we may assume Dr. Hunter's famine theory to be true, there is little difficulty in explaining the remarkable series of periodic crises which I have pointed out." The author goes on to show that the trade of Western Europe has always been strongly affected by communication with the Indies, several crises being distinctly traceable to this cause; thus the crisis of 1878 is clearly connected with the recent famines in India and China, and these famines are confidently attributed to solar influence. He states, then, that it is his present belief that to trade with India, China, and other parts of the tropical and semi-tropical regions, must be attributed the principal fluctuations of European commerce, although the decennial fluctuations ought not to be wholly laid to the account of Indian trade; it being quite possible that tropical Africa, America, the West Indies, and even the Levant are affected by the same meteorological influences which occasion the famines in India. Thus it is the nations which trade most largely with those parts of the world, and which give long credits to their customers, which suffer most from these crises. Professor Jevons sees nothing in his theory inconsistent with the fact that crises and panics arise from other than meteorological causes; but when such do happen, they

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seldom, if ever, have the intensity, profundity, and wide extension of the true decennial crises.

The conclusion which the author draws from his speculation is that "if there is any truth in all these sun spot speculations, there must be a periodic variation in the sun's rays, of which the sun spots are a mere sign, and perhaps an unsatisfactory one. It is possible that the real variations are more regular than the sun spot variations, and thus may perhaps be explained the curious fact that the decennial crises recur more regularly on the whole than the maxima and minima of sun spots."

To determine this mooted question, then, he suggests the importance of at once undertaking direct observations upon the varying power and character of the sun's rays; and to this end solar observatories should be established in every country where the sun can be observed most free from atmospheric opacity. If from such observations it be found, as will probably be the case, that the sun does vary, "the time will come when the most important news for the commercial world contained in the *Times* will be cablegrams concerning the solar power." And he adds that certainly an empire upon which the sun never sets cannot wisely neglect to keep a watch on that great fountain of energy, since "from it we derive our strength and our weakness, our success and our failures, our elation in commercial mania, and our despondency and ruin in commercial collapse."

PROGRESS OF THE SWEDISH ARCTIC EXPEDITION.

There is a strong probability that the Swedish Exploring Expedition, under Professor Nordenskjöld, has by this time proved the existence of an available northern passage from the Atlantic to the Pacific. In 1876 and 1877, Professor Nordenskjöld succeeded in reaching the mouths of the Siberian rivers Obi and Yenisei by way of the Kara Sea, a feat never before accomplished, thus establishing a new commercial road to the regions which those streams water. During the past summer, the expedition which sailed from Hammerfest, Norway, in July, successfully traversed the Kara Sea in the forepart of August, and arrived at Dickson's port, at the mouth of the Yenisei, on the 6th. Four days later the expedition, comprising two small but strong steamers, the Lena and the Vega, began the exploration of the hitherto untried sea to the north and east. By August 20, the northernmost point of Asia was passed, and in a week more the mouth of the Lena was safely reached. Here the steamers parted company, the Lena to ascend the river to Yakutsk, the Vega to continue the exploration of the Siberian coast, hoping within a few months to reach Japan by the way of Behring Strait. The greater part of the coast from the Lena to Behring Strait has already been explored by sailing vessels, so that the probability of the successful passage of the Vega is very great. Should it prove feasible to navigate those seas even during a few months of each summer, the commercial advantage of the new route between Europe and Eastern Asia and Western America will be considerable. Besides, it would open up to trade the northern half of the vast continent of Asia, by way of the great rivers Obi, Yenisei, and Lena.

Professor Nordenskjöld has already shown that trading vessels carrying profitable cargoes can reach the north of the Yenisei in August and September, and return with marketable freight before the Kara Sea is closed by ice. Should the entire route by way of the Arctic Sea prove practicable, the summer voyage from Europe to the East would be shortened about one fourth; but that advantage would be offset by the disadvantage of being closed by ice ten months in the year.

In any case the new Siberian regions opened up are likely to prove of great benefit to Europe, both in furnishing large supplies of food stuffs and raw materials, and in offering a market for manufactures. Siberia has made enormous progress in material development during recent years, and improved trade connections would give a great impetus to the new settlements. Fortunately American manufactures are highly esteemed in Siberia; and if a proper effort is made a large share of the new trade may fall to us. On the other hand Siberia is likely to become a serious rival to us as a producer of breadstuffs. Vast regions there are admirably suited for the cultivation of grain; and they will make themselves felt in the markets of the world as soon as means are provided for transporting the crops cheaply.

THE TRADEMARKS QUANDARY.

The attempts to better the law of trademarks by statutes have evidently muddled the subject. A Maryland judge has pronounced the law of Congress unquestionably constitutional; and jurists will generally agree that, if it is so, it has superseded State laws. But a Wisconsin judge is just as clear that the National law is a nullity; and one consequence of this decision, if sustained, would be that State laws are revived. Meanwhile the manufacturer cannot know under which law to act.

Before either law was passed courts of equity had built up a somewhat vague yet efficient system for perfecting the peculiar labels, unique designs, characteristic names, and fancy catchwords adopted by various manufacturers and dealers. Every producer of an article generally known to be good sets a value on the trademark with which it has become associated in the public mind, and will resist the employment of it by his competitors. The courts have sustained these claims; not so much, however, in the view that a trademark is property, as upon the ground of protecting the public from imposition. Any man may make and sell cologne or cocoa oil, pencils or piano-fortes, shawls or shirts; but if he sells them under the names and characteristic labels of old and distinguished dealers, the public are liable to be deceived. For the sake of the public the courts will stop such imitations by injunction, and if doing so also protects a meritorious manufacturer in the slowly-acquired reputation of his wares, so much the better. This was the old equity doctrine of trademarks. But it was a long and difficult inquiry, in many of these cases, which of the rivals was first in the use of the disputed name or emblem. To relieve this difficulty, to supply proof of the original ownership and use, is a leading object of the trademark statutes. Such statutes have been passed in England, by the Legislature of New York, and by Congress. They enable a dealer when he first adopts a trademark to register it as his own; and having done this, he can at any time appeal to the public record to establish his priority of design. Conversely, any one proposing to adopt a trademark can ascertain from the record whether the same design has been appropriated.

Our people have little concern with the English law; it is the confusion between State and National laws which needs remedy. The first National law appeared in 1870, as one chapter in a newly enacted revision of all the laws pertaining to patents and copyrights. This juxtaposition of subjects gave the impression that the law rests upon the power of Congress to secure to authors and inventors the exclusive right to their respective writings and discoveries. And now the objection is made that a trademark is not a writing or a discovery, and its designer is neither an author nor an inventor. Therefore the law is unconstitutional.

The objection is forcible, but an answer is offered that trademarks pertain to commerce, and that Congress has power to regulate commerce. Opponents of the law reply that it is commerce among the States which Congress may regulate, while trademarks belong primarily to domestic commerce, which Congress cannot control. Friends of the law contend that the National Government may make treaties, and treaties may properly stipulate for mutual protection of trademarks of subjects of one government within the dominions of another, and therefore Congress may pass a general trademark law as incidental to enforcement of treaties. And so the discussion slowly proceeds, with the effect of creating the dilemma that claims founded on either law may, at any moment, be adjudged invalid. For the power of Congress, if it exists, is exclusive; if it is disproved, then and then only are State laws operative. The New York *Tribune*, from which we select the above, concludes with everybody else interested in the matter, that the subject deserves early and final determination.

HOW TO UTILIZE OLD FRUIT CANS.

Perhaps one of the most appropriate uses of an old fruit can that can be devised is to make it contribute to the growth of new fruit to fill new cans. This is done in the following manner: The can is pierced with one or more pin holes, and then sunk in the earth near the roots of the strawberry or tomato or other plants. The pin holes are to be of such size that when the can is filled with water the fluid can only escape into the ground very slowly. Thus a quart can, properly arranged, will extend its irrigation to the plant through a period of several days; the can is then refilled. Practical trials of this method of irrigation leave no doubt of its success. Plants thus watered flourish and yield the most bounteous returns throughout the longest droughts. In all warm localities, where water is scarce, the planting of old fruit cans, as here indicated, will be found profitable as a regular gardening operation.

SENATE BILL 300.—SECTION 2.

In all discussions of patent rights with reference to Mr. Wadleigh's bill for the amendment of the patent law, it is needful to bear in mind the broad principle that Congress is empowered by the Constitution to grant to inventors the "exclusive" right to the manufacture and sale of the article or process patented. The right is limited in time, but it cannot be limited in scope. In other words Congress has no power to come between the patentee and his invention, to say what he shall do with it. Whether this provision of the Constitution is wise or not is beside the question. In our opinion it is eminently wise; but wise or foolish, there it stands, and can be got rid of only by an amendment of the Constitution, not by any change in the wording of the patent law.

The fatal objection to Section 2 of Mr. Wadleigh's bill is that it undertakes to limit the scope of the patentee's right. It provides that if the patentee chooses for any reason to share his right with A and B, giving them a license to use his invention or discovery, C, D, and all the rest of the alphabet may come in and enjoy the privilege on the same terms. Still worse, if the patentee elects to retain the entire control of his invention, his purpose may be thwarted, the penalty for the infringement being a license fee "determined from all the evidence in the case."

The purpose of the American patent law is to encourage the advancement of the useful arts through invention and discovery. Its object is to induce men to study and experiment and invent; and it seeks to accomplish that object by the hope held out to the inventor that by the enjoyment of the exclusive right to the manufacture and sale of a patented invention he will stand a better chance of gaining a fortune than would be otherwise possible. Once secured a patented invention is property, to be respected as other property is. The Constitution provides that during the life of the patent the owner of it shall be free from dictation or interference; so long, of course, as he uses it without direct injury to himself or others. In other words, his right is as exclusive as his right to a horse or a gun, or a house that he has reared or bought or made.

What would be thought of the wisdom of a legislative body which should enact a law to the effect that in case A lends his horse to B, for friendship or hire, any other man might use the horse on the same terms? Or in case A should decline to lend his horse, B's unauthorized use of the animal would be punishable only by the payment of the customary license fee of the livery stable? Similarly if A allows B to plant a potato patch in the corner of his farm, the whole farm shall be laid open to invasion on the same terms? Or if C wants to occupy a room in D's house he shall be allowed to do so on payment of such rental as some one else shall decide to be sufficient?

Is there any less absurdity or injustice in making parallel provisions with respect to invasions of patent rights?

As a rule it may be said that the work of inventing a novel and useful device is less arduous and costly than the work of introducing it. As a rule, too, the inventor is very apt to be without the means needful to develop and introduce an invention so as to make it pecuniarily profitable. Accordingly very favorable terms may well be offered to the first to take hold of and work up a new invention. The risks are great, and the promise of ultimate profit should be correspondingly great. Would any cautious business man be willing to assume such risk if he knew that when the profitableness of the invention came to be successfully demonstrated, any one else could step in and use the perfected invention at no greater risk than the payment of a license fee?

The great trouble with the framers of devices for facilitating the invasion of patent rights, like this second section of Mr. Wadleigh's bill, arises from their proneness to forget the grand purpose of the American patent system—the advancement of the useful arts by the encouragement of invention—and the not less vital point that the only means for the attainment of that end contemplated by the framers of the Constitution was the recognition of the inventor's exclusive right to the control of his invention or discovery during the period for which the patent should be granted.

It would no doubt be very pleasing to such as are or desire to be infringers upon patent rights, to have the inventor's exclusive right laid open to invasion. But the patent law was not framed to meet the wants of infringers, and Congress has no constitutional power to alter it in their favor.

BOILER FEEDERS FOR LOCOMOTIVES, ETC.

Among the improved appliances in this line proven by practical tests to possess superior merit, the Hancock Inspirator may be especially mentioned. The company's business announcement will be found in our advertising columns. The performances of this apparatus are in some respects remarkable. E. Howard & Co., the well known watch and clock makers, have one in use which they say draws the water from a driven well, some 75 feet distant, and a perpendicular lift of 20 feet, and also forces the water, when needed, 70 feet up into a tank at the top of the building.

For locomotives they are especially useful. Mr. James K. Taylor, master mechanic of the Old Colony Railway, states that every one of twenty-three of these feeders, now in use on the locomotives of the above company, is giving great satisfaction. Not one has had to be taken off for repairs. They supply all the water required by the engines, are found more reliable and economical than any pumps, which latter they do not hesitate to remove. They are more positive in working, less liable to clog, have greater range than any other device, and require less attention from the engineer in working them. Practical indorsements of this sort are worthy of the highest consideration.

An Economical Engine.

A compound condensing pumping engine, erected for the Buffalo (N. Y.) High Service Water Works, by the Holly Manufacturing Company, of Lockport, N. Y., recently tested under the supervision of Professor Greene, President of the Troy Polytechnic Institute, developed a duty of 80,489,638 foot pounds per 100 lbs. of coal. Following are the elements of the test:

High pressure cylinder, 1, diameter, inches	25·
Low pressure cylinders, 3, diameter, inches	25·
Double-acting pump cylinders, 4, diameter, in.	15·5
Length of stroke of each cylinder, inches	33·
Total number of revolutions	25,650
Duration of test	20h. 15m.
Revolutions per minute	21·12
Piston speed per minute, in feet	106·16
Pressure on water gauge, in pounds	46·76
Pressure from reservoir supply, to be deducted in pounds	5·58
Actual water pressure, or load on the pump, in lbs.	41·18
Coal consumed, no deductions, pounds	5,400
Steam pressure, pounds	61·5
Vacuum, inches	26·5
Temperature of injection water to air pumps, degrees, Fah.	48·
Temperature of water in hot well, degrees, Fah.	92·
Temperature of feed water to boilers, deg., Fah.	170·
Air pumps, two single acting, diameter, 24 in. stroke, 30 in.	
Suction and discharge pipes, diameter, 24 in.	
Fly wheel, diameter, 12 ft. 4 in.; weight, 7 tons.	
Duty in foot pounds, per 100 pounds of coal	80,489,638

This engine is similar to that described in the SCIENTIFIC AMERICAN, vol. XXXIX., p. 95, and in SUPPLEMENT No. 140.

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A Mammoth Farm.

A correspondent of the Troy *Times*, traveling in Dakota, writes from Fargo, a town, he says, now only eight years old, containing 6,000 inhabitants, describing the cultivated farm of William Dalrymple, containing an undivided estate of 50,000 acres, extending 12 miles along the fertile bottom lands of a most beautiful river, and then back into the interior 11 miles more, the whole covering an area of over 30 square miles.

Of this, 20,000 acres were last year sown in wheat, which has yielded 250,000 bushels as reward for the husbandman's toil. The soil of this Red River farm is peculiarly rich, and adapted to the production of just the cereal cultivated. The upper surface is an alluvial deposit of great fertility, under which is a deposit of marl, containing in large quantities the phosphates and silicates needed in the formation of the berry and the stalk of wheat.

Of course it would be impossible to operate such a farm from one headquarters, so the land is apportioned into subdivisions of 2,000 acres each, every one of which is presided over by a superintendent, who is under the direction and orders of the owner. Each chief overseer has a nice house, in most cases handsomely fitted up, and finished, in several instances, in most excellent taste. Near the superintendent's house is the hands' boarding-house, where all the harvesters board. Back of these buildings are located the granaries and stables, and, a little further removed, the machine shops, engine rooms, and windmills. All the buildings follow a plain but quite attractive style of architecture, and answer every purpose intended. Each subdivision has the same set of buildings, and is operated in quite the same way.

To run the farm it requires the services of 450 men and over 300 horses and mules; to keep the accounts, 3 bookkeepers and 2 cashiers are kept constantly busy. Water is pumped by windmills several miles back into the interior from the river. 75 Wood's reapers and binders are used in the harvest, and pile up yellow sheaves at the rate of 1,000 acres per day. During the entire harvest season last year they were retarded only one half day by inclement weather. The grain is separated from the straw by 18 steam thrashers, which puts it in the bins at the rate of 1,000 bushels per day.

STRAUB'S SCIENTIFIC GRAIN MILL.

We give herewith engravings representing in different views a mill for grinding grain, middlings, minerals, and

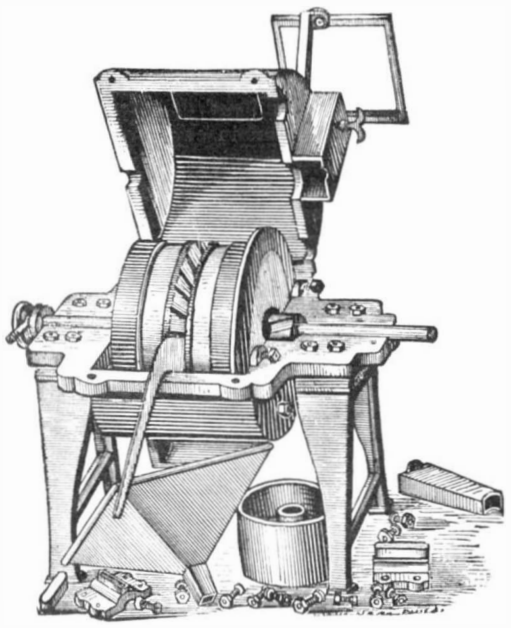

Fig. 2.—STRAUB'S MILL OPEN.

paint, which is known as Straub's Scientific Grain Mill. It is claimed by the manufacturers of this mill that burr stones revolving in a vertical plane are more effective than horizontal stones of double the diameter, running very light and steady and grinding faster and cooler than ordinary stones. The principal requirements in a mill of this character are to have the parts accurately fitted and rigidly held in position; to have a ready means of taking up wear, and to have it so simple that it can be readily understood and managed by any one likely to require such a mill. The manufacturers of the scientific grain mill claim to have met these requirements. Fig. 1 is a perspective view of the mill, giving a good idea of its external appearance. Fig. 2 shows the mill opened, with the bar between the stones which is employed to lift them from the casing and place them in position for dressing, as shown in Fig. 3.

This mill has a silent feed and is adapted for grinding wheat flour; regrinding middlings; grinding corn, oats, and feed; and it may be used for grinding minerals, gold quartz, rock, slate rock, fire brick, dyewood, bone, cochineal, foundry facing, and whatever can be ground by French burr stones. It is especially adapted to farm and plantation use, as the smaller size may be driven by hand or horse power.

Further particulars may be obtained by addressing the manufacturers, Messrs. A. W. Straub & Co., 2231 Wood street, Philadelphia, Pa.

[*Continued from first page.*)

conductor of heat and electricity, the purest carbon known next to the diamond, and is capable, the manufacturers claim, of being divided finer than any other known substance. Its proper color is that of a darker shade of fractured steel. Its best known use is for pencils, and the next is, perhaps, for crucibles and refractory mixtures, and then as a conducting coating for galvano-plastics. Its unchangeable character

THE RAILROAD, WITH BUNDLES OF PENCILS.

and smoothness have attracted much attention to it as a lubricator. The use of graphite for lubricating is not new. It was used for that purpose more than 200 years ago; but the want of a pure article prevented its adoption to a large extent. Within the past few years the Dixon Company have taken the matter up in earnest, and have succeeded in producing graphite of purity and free from grit, at a price that must bring it very largely into use for lubricating. Its well known properties have caused many persons to mix it with oil or grease or apply it dry to journals, and their disappointment has caused them to condemn the article, the graphite being of inferior quality. The brand of graphite prepared by the Dixon Company, known as the "Perfect Lubricator," has cured, it is stated, the step of a mill of heating when every other tried means had failed.

A grease is now being prepared by the company, for use in mills and for railroads, steamboats, cylinders, gearing, bearings, slideways, etc. The company has named the article "Dixon's Everlasting Graphite Grease." For this grade of graphite the company was awarded the gold medal at the Paris Exhibition of 1878.

The most interesting mechanical processes in the Dixon Works are to be found in the Pencil Department, which is illustrated on our first page, the large engraving showing the several operations of making the leads, gluing the pencil strips, and bundling the pencils. The smaller cut shows the machine for shaping the pencils. The graphite is divided as finely as mechanical means will permit, and is then floated through several tubs or vats, placed one above the other; the coarsest of the particles will settle in the first vat, the next coarsest in the next vat, and so on till the finest have lodged in the last, or lower vat.

A very smooth, blue clay is dissolved in the upper vat, and floated in the same manner, the finest being gathered into the lowest vat. The finest clay and the finest graphite are mixed together for the finest pencils. The proportion of clay determines the grade of hardness of the pencil when finished, the more clay the harder the "lead." After the materials are mixed together the plastic mass is placed in a "well." A screw press follower presses the material out through a hole in the bottom of the well, when it coils up like a thread under the machine, so that it may be handled like a skein of yarn.

It is then straightened out in lengths, dried, placed in a crucible, and submitted to a high heat and baked like earthenware for some hours. The "leads" are then strong enough to be handled like knitting needles. The cedar boards are sawed into suitable lengths and of a width for six pencils. They are run through a machine that planes and grooves them on one side, nimble fingers place the leads, the two halves or boards are glued together, and they are ready for the shaping machine. The little blocks enter at one side of the machine, and the pencils fall into a basket at the other side at the rate of 216 per minute. An ingenious contrivance counts them. On leaving the shaping machine the pencils are about as perfect as woodwork can be made. They pass thence into the finishing room, where they are varnished and finished in any desired color, stamped with the title and grade and packed in boxes for sale. Eighty-six thousand pencils per day are now passing through the works, made throughout by machinery, and claimed to be more perfect than is possible by hand labor.

The Dixon Company not only produced its own machinery for the manufacture of the pencils, but maintained the idea of originality by adopting a system of stamps for the different grades. The whole system of pencil manufacture is, in the Dixon Company's works, original and interesting. The machines are mainly automatic, but very simple. The finest grades of pencils for artists and draughtsmen are manufactured by this firm. The company are the only pencil manufacturers, we believe, that were awarded a gold medal at the Paris Exhibition.

A Canadian Gold Mine.

Dr. Laflamme, of the University of Laval, Quebec, favors us with a photograph, natural size, of a nugget of pure gold,

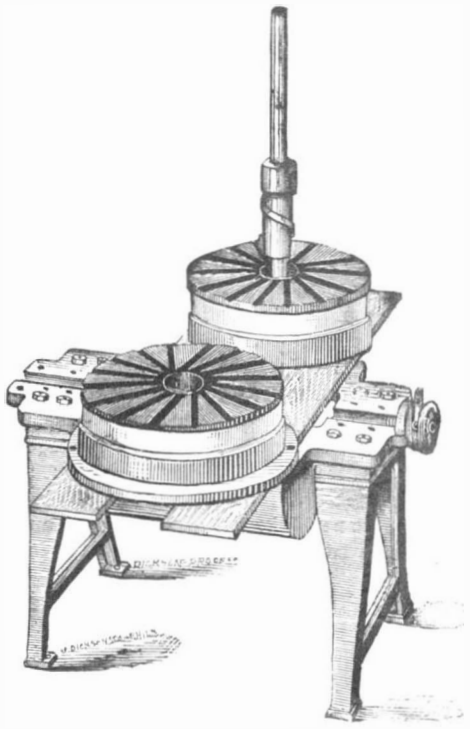

Fig. 3.—STONES IN POSITION FOR DRESSING.

weighing 38 ounces, lately found in the gold mine worked by Messrs. L. Saintrouge & Co., in Beauce County, near Quebec. The mines are said to be very rich, two weeks' work having furnished 150 ounces of gold; number of men employed not stated. The means employed, however, are described as of the most primitive character. The gold is found in bowlder clay underlying glacial drift, also in quartz accompanying the clay, but not in large quantities.

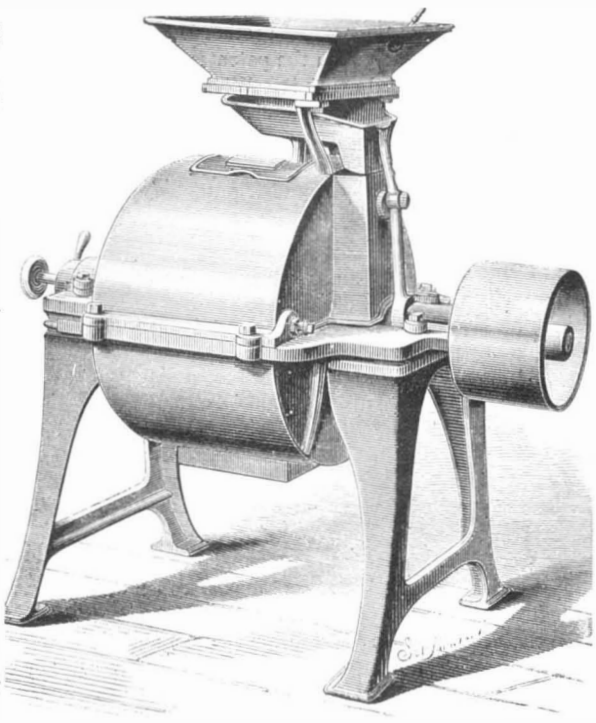

Fig. 1.—STRAUB'S SCIENTIFIC GRAIN MILL.

Recent Engineering Inventions.

An improvement in Methods of Connecting Sputs to Boilers has been patented by Mr. John Trageser, of New York city. This invention consists in a sput formed with an annular recess or cavity around its body, into which recess the edge of the opening in the boiler is calked and the joint afterward brazed

Mr. George Elliott, of New York city, (P. O. Box 2336), has patented an improved Paddle Wheel, the paddles of which are so constructed as to diminish the velocity of the middle portion of the current of water set in motion by the paddles, in order that the remaining portion of the said water may be made efficient, and the combined action of the different parts of the paddles upon the water may be more effective for the propulsion of the boat. The paddles are made in the form of rectangular parallelograms, and have elliptical apertures through the middle.

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THE COLUMBIA BICYCLE.

The bicycle furor which pervaded this country and Europe a few years ago has subsided into a solid interest in this means of locomotion, which is much more noticeable in England than in this country, although the bicycle is now very popular here, and is daily becoming more so. It has arrived at great perfection, and is constructed more scientifically than formerly It is of great practical utility as well as a rational means of amusement. It is, in fact, an ever-saddled horse that eats nothing and requires no care.

Undoubtedly the most perfect bicycle now made is the "Columbia," manufactured by the Pope Manufacturing Company, of 87 Summer street, Boston, Mass. This machine, which is shown in our engraving, has a steering head which is one solid forging. The backbones, which are made of steel, are large, light, strong, and rigid. The spring is attached by a joint to a small plate sliding on the backbone. The wheels are of the spider pattern, with steel V shaped fellies, with forged steel hubs, hardened in bearing parts. The back wheel and pedals run on coned bearings, one being adjustable, and are made so as to prevent the admission of dust and dirt. The front wheel bearings are conical and well hardened, and fitted with coned fastenings of India rubber, 1 inch on the front and ¾ inch diameter on the back wheel.

In the modern bicycle the seat is placed almost directly over the center of the front wheel, by which means a much larger wheel can be ridden, thus gaining in speed and making the act of propelling it more like walking, instead of pushing with the feet as in the velocipede, which is tiresome and injurious to the rider. Although our bicyclists have had very little experience compared with English riders, yet some long distances worth mentioning have been made. On November 27, 1877, Mr. A. D. Chandler rode from Leominster to Boston, a distance of 40 miles, in 4 hours. May, 1878, Russell Sharp and John Storer, from Boston to Newport, R. I., 72 miles, in 13 hours, including stoppages. Actual riding time, 10½ hours. August, 1878, H. E. Parkhurst rode from Clinton to Boston, 44 miles, in 5½ hours, without a stop, making the distance from South Framingham to Boston, 20½ miles, in 2 hours. Has also ridden from Boston to Natick and return, without a dismount, 36 miles in 3½ hours. October, 15, 1878, E. W. Pope and F. S. Jaquith rode in the suburbs of Boston, 77 miles in 11 hours, including stops. After having ridden 60 miles they made the distance from Wellesley to Newton, over 7 miles, in 38 minutes. October 19, 1878, G. R. Agassiz, on the Chestnut Hill road, traveled one mile in 3 minutes 21½ seconds, winning the Boston Bicycle Club Gold Medal. E. Costen and F. Smythe, September 2, 1876, on a turnpike road, made 205 miles in 22 hours.

We give a record of some professional and amateur bicycle runs made in England:

Quickest professional times—October 2, 1876, J. Keen, Molineaux Grounds, made 1 mile in 2 min. 56 1-5 secs. Same party, December 8, 1876, Lillie Bridge, made 10 miles in 33 minutes. Same rider, on same date and place, 20 miles in 1 hour 5 min. 34 sec. The same, October 9, 1876, Lillie Bridge, 50 miles in 3 hours 6 min. 45 sec. October 19, 1874, D. Stanton, Lillie Bridge, 106 miles in 7 hours 58 min. 54 sec. The same, March, 1878, Agricultural Hall, London, 1,000 miles in 6 days.

Quickest amateur times—T. T. East, Lillie Bridge, 1 mile in 2 min. 56 sec. September 11, 1875, W. Tylerson, Lillie Bridge, 10 miles in 34 min. 40¾ sec. May 15, 1876, Hon. I. K. Falconer, Cambridge University Grounds, 50 miles in 3 hours 20 min. 37 sec. June 10, 1878, F. E. Appleyard, turnpike road, Bath to London, 100 miles, in 7 hours 18 min. 55 sec. Stanley Thorpe, turnpike road from London to York, 105½ miles, in 22½ hours.

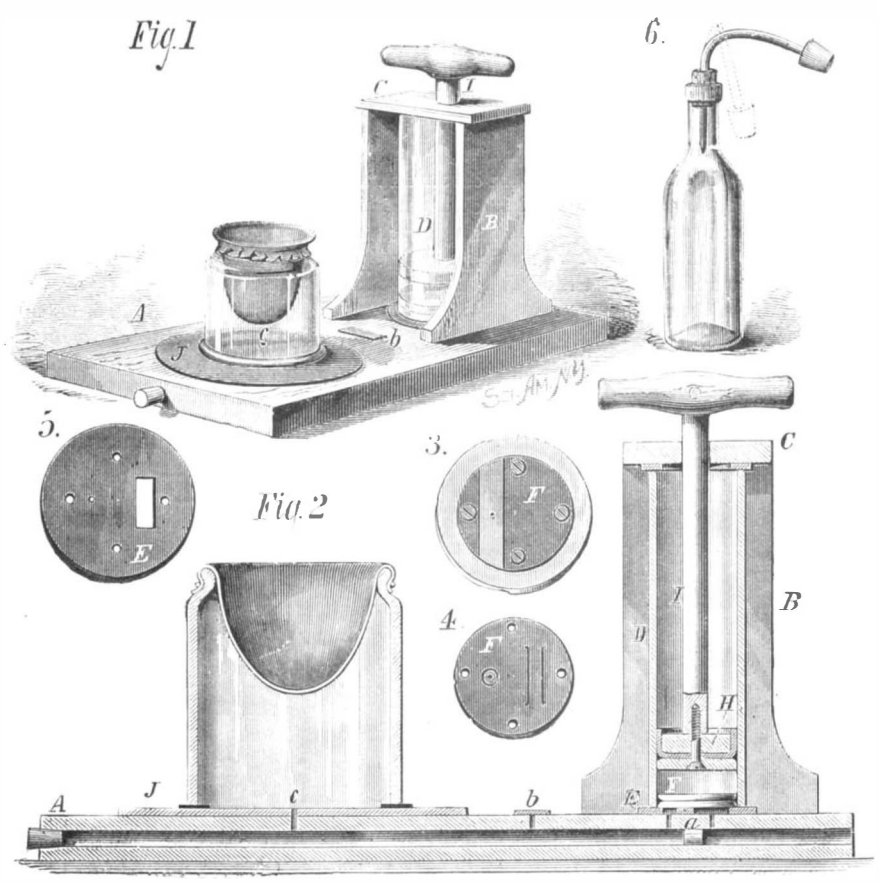
THE COLUMBIA BICYCLE.

EASILY MADE PHYSICAL APPARATUS.

BY GEO. M. HOPKINS.

But for the glass in the doors which imprison the physical apparatus in many of our institutions of learning, students would have little idea of the form or construction of the instruments, so many of which are now made for illustrating scientific principles, but which, alas! are doomed to eternal rest. Through fear of accident; through lack of confidence in their own ability to properly conduct experiments; or through indisposition to perform more than the absolutely necessary work, teachers too often ignore practical demonstration and permit students to rely on knowledge conveyed by text books, many of which are full of errors, while others lack that clearness, thoroughness, and conciseness which are necessary to a ready comprehension of the principles taught; in fact they are generally full of instruction on every point excepting the very one upon which instruction is most needed. There is scarcely a principle in physics that may not be easily demonstrated by experiment, and in the majority of cases the apparatus may be extemporized. To the young, one of the most interesting and instructive instruments is the air pump, as with it much that is daily seen and experienced may be explained.

The engraving shows in perspective in Fig. 1, and in section in Fig. 2, an air pump which may be readily made. The base, A, is a perfectly plain board, 8 inches wide, 15 inches long, and 1 inch thick. A 3-8 inch hole is bored longitudinally through the center, and near one end, two 1-16 inch holes are bored into the longitudinal hole at *a*, 3-4 inch apart. Another 1-16 inch hole is made at *b*, and another one at *c*. The board may be of any well seasoned wood that is not liable to warp. After boring it should receive several coats of good alcoholic shellac varnish on all sides and in the holes. When the last coat is applied a 6 inch disk, J, of elastic packing rubber, having a small central aperture, and which has previously received a coat of the same kind of varnish, is placed varnish side down upon the board with its central aperture coincident with the hole, *c*, in the board, and it is kept in position under slight pressure until the varnish dries, which will take a considerable time (a day or so), being confined between the two surfaces. To the base, A, two wooden standards, B, are secured, each 6 1-2 inches high and about 2 inches wide at the narrower end and 1-2 inch thick. They are two inches apart and are connected at the top by a cross piece, C. The base, A, standards, B, and cross piece, C, should be fastened together with long screws. The pump barrel, D, is a piece of glass tubing 1 1-2 inches internal diameter, and 6 inches long. A piece which is as nearly true and straight as possible should be selected. It may be cut from a long piece by turning it in a heated loop of heavy iron wire, which half encircles the tube. The tube should be turned back and forth at first until it begins to crack, when it should be turned slowly in one direction until it cracks entirely around. If the ends need to be squared up they may be readily ground upon an ordinary grindstone, or by moving it with a gyratory motion upon a slab of glass having on its surface some coarse emery and water. A piece of mandrel drawn brass tube will answer as a barrel equally as well as the glass tube.



A SIMPLE AIR PUMP.

The lower end of the pump barrel rests upon a soft rubber disk, E, and a ring of the same material is placed between the cross piece, C, and the upper end of the barrel. The rubber disk, E, has an oblong aperture, also a small circular one, as seen in Fig. 5. The oblong aperture is placed over the right hand hole at *a;* the small aperture over the left hand hole.

A disk, F, Fig. 4, of hard rubber, brass, or other suitable material, having its edge grooved, and having two small apertures (1-16 inch) which coincide with the holes at *a*, is covered on its under side with oiled silk, which is drawn over its edges and fastened by a stout thread wound in the groove. Two slits are cut in the oiled silk, one upon each side of the right hand hole, making a valve which works in the little chamber formed by the oblong hole in the packing disk, E; the oiled silk is removed around the left hand hole. The upper valve, which is shown in Fig. 3, consists of a strip of oiled silk, which covers the left hand hole and is fastened by a thread around the edges of the disk, as in the other case.

The disk, F, is placed upon the packing disk, E, and secured by four small screws that pass through both into the base.

The piston, H, consists of two disks of wood, which have been soaked in melted paraffin to prevent them from absorbing moisture. The lower one nearly fills the barrel; the upper one is small enough to receive between it and the barrel a leather packing, which is turned upward in the same manner as the packing of an ordinary cistern pump. The piston is fastened to the end of the wooden piston rod, I, by means of a long wood screw. The piston rod passes upward through a hole in the cross piece, C, and is provided with a suitable handle.

A rubber stopper is forced into the longitudinal hole in the bed to a point between the two holes at *a*, and another rubber stopper closes the opposite end of the hole. An oiled silk or flexible rubber flap or valve covers the hole, *b*. The piston should be greased with lard. By adding to the piston a second packing turned downward the pump may be used for the compression of air.

Any of the experiments performed with other air pumps may be repeated with this. A bottomless glass jar is shown in the present case upon the soft rubber disk, J. It has a thin piece of elastic rubber stretched over its mouth, and tied when the air is exhausted. External air pressure forces the elastic rubber downward. By substituting a piece of bladder for the rubber, it will burst with a loud report. By placing the hand over the mouth of the jar and exhausting the air, the fact that the air has weight will at once be realized.

A strong common fruit jar may be used as a receiver, and to insure a perfect joint with the rubber disk, a packing ring of very soft rubber may be interposed between the mouth of the jar and the rubber disk, J, and in any case the rubber disk and whatever is placed on it should be greased with lard to make a joint.

The fountain in vacuo requires no expensive apparatus. All that is needed is a small tube or jet, which may be either of metal or glass, a piece of stiff rubber tubing, and two good corks or rubber stoppers. One of the corks is inserted in the bottle and the jet is inserted in the cork, the rubber tube is slipped over the outer end of the jet tube and is fitted to a hole in the second cork, as seen in Fig. 6.

To exhaust the air from the bottle stop the hole, *c*, insert the cork that is on the end of the rubber tube in place of the stopper in the end of the bed. Work the pump, and when the air is exhausted bind the rubber tube, as indicated by the dotted lines, so as to close it; raise the valve from the hole, *b*, to admit air to the passage in the bed, and remove the cork on the rubber tube from the hole in the bed, and dip it in a vessel of water, at the same time allowing the rubber tube to straighten out.

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To illustrate the principle of the Magdeburg hemispheres, make a ring of wood a little larger than a tumbler top, soak it in melted paraffin, attach to each side a packing ring of very soft rubber, fasten in one edge a piece of rubber tubing, which communicates with the interior of the ring; place on each side of the ring a tumbler with its mouth in contact with the packing ring; exhaust the air as in the case of the fountain bottle, and prevent its re-entrance by bending the tube short. The tumblers will press so firmly upon the ring that it will be difficult, if not impossible, to separate them from it.

It is not necessary to enumerate here the many interesting experiments that may be made with an air pump, as most of them are well known. If the construction of the pump has been made so simple as to enable the young readers of the SCIENTIFIC AMERICAN to construct one, the object of this article will have been attained.

THE LURAY CAVERN

BY H. C. HOVEY.

The marvels of this cave, lately opened in Page County, Va., have been made widely known through the columns of the New York *Herald*. Especial credit is due to Major A. J. Brand and J. J. Collins, C.E., for their graphic accounts, which have less of fancy and more of truth than commonly characterize the reports of enthusiastic explorers. We confess, however, that at first we were skeptical, and that our doubts have only been removed by an actual survey. And now, having gone through every avenue, hall, gulf, and gallery, and enjoying excellent opportunities for comparison with other caves elsewhere, we add our testimony that Luray Cavern may be safely counted among the chief wonders of the world.

The object now arrived at is to classify and explain phenomena, rather than to describe what is merely grotesque or beautiful, unless the ends of science may be thus promoted. Many of the things to be considered are so novel and ornate that any statements of their peculiarities, however coolly made, must seem florid and overdrawn to persons not familiar with cave scenery.

A cursory glance at the geology of the region will aid us in handling our subject. The official surveys are meager, and we had to rely chiefly upon such observations as could be made along the line of railroad from Harper's Ferry to New Market, where alternate beds of slate and limestone, displaced by volcanic upheavals, dip at an angle of 30° eastward into the Shenandoah valley. Crossing the lofty Massanutten range once by stage and the second time on foot, for the purpose of closer inspection, we saw impressive signs of the stupendous forces that have modified the original strata, lifting them vertically, and sometimes even inverting them. Amid all this rugged violence the general symmetry of periods is preserved; rising from Silurian limestones, through sub-carboniferous rocks, to thin deposits of coal said to lie on the highest peaks, and then descending through the same formations down the eastern slope.

This synclinal arrangement brings to view again in Page County the Lewisburg limestone (Formation II. of Rogers' Survey), which Fontaine locates between the Vespertine strata underneath and the Umbral series above. In this blue limestone, of the lower carboniferous period, many caves are found, the most noted of which, hitherto, has been the unique and attractive Weyer's Cave, about 1,600 yards long, and whose features were well described a few years ago, by Porte Crayon, in *Harper's Magazine*. It is in this same formation, indeed, as it appears with various modifications in different parts of the globe, that the most remarkable caverns in existence have been discovered; so that it is often spoken of by geological writers as the cavernous limestone. But in Virginia it has its peculiarities.

Volcanic action has been so powerful and recent, comparatively speaking, that masses of igneous rock are actually thrust through the sedimentary rocks, so that there is a dike of trap within a mile of Weyer's Cave. The veined condition of the limestone in Page County is due to such disturbances, by which it has been cleft into countless fissures, that were afterward filled by calc spar and silicates, with occasional streaks of the oxides of iron, manganese, and other metals and minerals, that play an important part in coloring the hard carbonates deposited on the walls of the underlying caverns. The loose rocks scattered on the surface are chiefly calcareous, often silicified, with occasional groups of quartz crystals and bowlders in the beds of streams.

The limestone in place is very compact and fine-grained, breaking with sharp edges. The color varies from light brown to deep blue, or even black, streaked, however, with fibers and veins of milk-white spar. Weathered surfaces are almost always stained with the oxide of iron. The analysis of five different specimens, from Luray and vicinity, showed an excess of carbonate of lime with from ten to forty per cent of the carbonate of magnesia, and even in one instance amounting to dolomite.

The valley of Luray is fertile, watered by the Hawksbill Creek, a tributary of the Shenandoah, and 150 miles from the sea coast. It is embosomed between the Massanutten range on the west and the Blue Ridge on the east. These ridges lie in vast folds and wrinkles, the fissures being often filled with metallic ores. Elevations found in the valley are, of course, such masses as had coherency enough to resist the wear of retreating waters by which gaps were opened in the mountain chains. Yet, as might be supposed, the lower hills are often pierced by the action of such mighty floods; and it is hardly necessary to refer any of the changes observed in these tunnels and hollows to the operation of volcanic forces. Water is as energetic as fire.

These geological conditions, thus hurriedly described, are favorable to rather deep and extensive excavations, marked by picturesque diversities and stalactitic ornamentation: but limited by the rapidly succeeding undulations of the surface and rifts dividing the strata.

There is no possibility of finding such immense domes, long avenues, and navigable rivers as characterize Mammoth Cave and others found in the vast, undisturbed, and homogeneous limestones of Kentucky and Indiana, varying in thickness from 50 to 500 feet, and oftentimes lying so nearly in their original position as to cause the surface above to assume the form of broad table lands, broken only by the sink-holes peculiar to all cave regions.

For more than fifty years an eminence a mile west of Luray has been known as Cave Hill. Climbing to its summit, which commands one of the finest views in the Old Dominion, we found a noble grove of pines and oaks, amid which is the pit-like entrance to Ruffner's Cave, full of drifted leaves and perilous of access. It has long been an object of local interest, but we explored it for only a short distance in order to ascertain its temperature, 60°, and its bearing, which is N. N. E.

Cave Hill is about 300 feet above the water level, toward which it slopes gradually, with many oval hollows called sink holes, each of which must have a subterranean outlet. Their axis invariably coincides with that of Ruffner's Cave, confirming the popular opinion that all the underlying cavities are in some way connected. One of these sink-holes on Mr. Brodus' land is fully 1,000 feet in diameter and 50 feet deep. Others at least two thirds as large are in adjacent fields.

At the foot of the long declivity, and at the distance of about a mile, is a pond near Blackford's furnace, fed by what is regarded as an unfathomable spring. A 50 pound weight attached to a cord 80 feet long failed to reach the bottom, and there is a legend of a wagon with four horses and the driver being swallowed down in this aqueous abyss without a vestige remaining. Doubtless it is really very deep, extending down to the level of Hawksbill Creek, and the volume of water it constantly pours forth is probably the drainage of all the cavities in the hill.

There is a small sink-hole about 70 feet lower than the summit and 320 paces N. E. from the mouth of the old cave. The crevice in the bottom of it was long since filled with stones and the space was overgrown with briers. Study of the topography led Messrs. Campbell and Stebbins to remove these obstructions, and dig through into what is now known to all the world as the Luray Cavern. That was done on the 13th of August, 1878. They only explored about 200 feet to a muddy pool, which they had there no means of crossing; and accordingly they returned to the surface, filled up the pit again, kept their secret, and bought 30 acres, including both the new orifice and Ruffner's Cave. Having thus gained possession by the double title of discovery and purchase, they proceeded with commendable enterprise to open their underground territory and make it accessible to the public.

Bridges have been thrown across pools and chasms that lie athwart the path; plank walks and tan bark have been laid down wherever needed on the main line; a large room at the further end has been floored; chandeliers are hung at several suitable points; railings guard the more dangerous places, and a building over the entrance is in process of erection for offices, dressingrooms, a cabinet, a dining hall, and other conveniences. Although but a portion of the cave is yet on exhibition, it has been visited by about 800 persons.

Mr. Stebbins was busied with these improvements, and we gladly accepted the services of Mr. A. J. Campbell as guide, whom we followed through every gallery and winding way, except three or four rooms now flooded by recent rains, and even into these we peered by the aid of fireworks, so as to get some idea of their dimensions and attractions.

Previous to our visit the cavern had never been illuminated by any better means than common lamps and candles in tin reflectors, or perhaps in a single instance by a few little tableaux-spirals. Anticipating this deficiency we had supplied ourselves beforehand with several pounds of the best quality of chemicals for making red and blue fires; and also with a large coil of magnesium ribbon, which we used very freely, as it burns with an intense white light, and emits no odor nor smoke, the sole product of combustion being wreaths of the pure oxide of the metal quickly falling to the ground.

The atmosphere within the cave is free from all hurtful gases, although Mr. Campbell has usually taken the precaution to lower a lighted candle into any pit he was to explore, in order to detect the presence of foul air. On the other hand we perceived no excess of oxygen, such as surcharges the atmosphere in caves where there is an abundance of saltpeter actively combining with lime and emitting free oxygen. The air is not exhilarating; it is merely wholesome and good to breathe everywhere, even in the deepest recesses. It sustains combustion well; but light seems to lack its usual power, owing to the fact that the atmosphere is optically as well as chemically pure. That is, there are no motes, or spores, or discernible atoms of any sort floating about, as in the sunbeams, each of which has its duty to perform in reflecting rays of light. In other words, cave chambers need a more powerful illumination to produce a given effect than would be required in a dark hall or church of the same size. This serves to explain the fact that the most honest observers nearly always have exaggerated estimates of cave distances. In one instance a room said to be 100 feet long, dwindled to 60 on measurement. Less extreme cases are common, and the cause of illusion having been pointed out, the necessity is evident of relying on the tape line rather than the eye; and where this is impracticable estimates should be cautiously made and from different positions.

The temperature observations made in all parts of the cave show an atmospheric range from 54° to 63°, averaging about 58°, which is 2° above that of Mammoth Cave, as fixed by repeated experiments made last summer. The temperature of the various bodies of water was about 54°. The mercury stood at 50° at the entrance. Hence there was a draught inward instead of outward, as would be the case in warm weather. The fact of fluctuations in the currents of air, in different parts of the cave, prove the existence of other openings than the one now known; and this ventilation aids us to understand the delightful purity of the cave atmosphere. It may be laid down as a rule in underground exploration, that wherever the draught changes, as indicated by wavering lights, an opening is near, either to the upper air or to some large arm of the cave.

A stairway of solid masonry leads down to the Vestibule, 30 feet below, where are stands and benches for the use of visitors. It is lighted by a chandelier hanging from the tip of a stalactite. It is a place of preparation. Putting on stout boots, overalls, and caps, and taking the tin reflector with its three candles provided for every visitor, we are ready to go on. The compass shows our path to lie due west. The eye, as soon as it has accommodated itself to the change of scene, is at once attracted by figures grotesque and majestic. Seldom does a cave have so fine an ante-chamber. On our right is the adit, now closed, through which the first explorers forced their passage. On the left is Specimen Avenue, from which the proprietors get most of the mementos tourists are allowed to take away. Next to it is Stebbins Avenue, which we leave, as we also do other side avenues, to be examined after we have followed out the main line.

Only ten paces in front of us is Washington's Pillar, broader at the base than at the top, a stalagmitic mass rising 25 feet from floor to roof, with a long diameter of 30 feet and a short one of 14. Its sides are fluted and jointed. The material is pure white carbonate of lime, fine grained, but not equal in quality to many to be found further within. A basin filled by trickling rills from the roof lies alongside the pillar. Against the opposite wall are rounded masses reminding one of the glyptodon and other monsters exhibited in museums.

Between a petrified cascade and a fossil garden we descend 18 steps to a lower floor, the roof retaining its altitude and supported by long slender shafts of alabaster. Brown buffaloes seem to hang from the roof, which on inspection were found to be spongoidal in appearance and blackened by the oxide of iron. They are really the network of silicious veins running through the limestone and remaining after the latter has been dissolved by acidulated water that would not affect silex. The floor was once lower than it now is, having been filled in by debris and washings from without. Fringed galleries mark the upper tier.

Next is the muddy lake already referred to as having put an end to the first exploring trip. On the second it was crossed in a small boat, and now it is bridged. It lies in a chasm from 12 to 30 feet wide and 75 in length. Midway there is a natural arch 4 feet wide and 8 high, through which the bridge is built.

The fish market is beyond this lake, getting its name from a row of folded stalactites, wet and shining, quite like a long string of black bass and catfish.

A hundred feet further on the way is obstructed, but with a small orifice through which a passage might be forced that would only lead to a point that is already accessible from another direction.

Our path now turns at right angles, up a flight of 25 steps, due north, to a floor on a level with the Vestibule. The roof is at this point nearly bare of ornaments. The floor is a bank of chalky substance, no doubt the product of disintegrated carbonates. The distance from floor to roof is only about 5 feet. But the width of these galleries is immense. We dispersed lights here and there in order to get some idea of their extent, and judged it to be 200 feet in one direction and 500 in another. The dimensions will more probably exceed than fall short of this estimate. Rambling to and fro we found many water-worn stalactites and columns half eaten through. This was plainly once a spacious hall, though now nearly obliterated by calcareous deposits and debris. It has been named the Elfin Ramble.

Trenches have been dug on the line of travel to enable persons to walk erect who prefer doing so to roving around as we delighted to do, spying out the secrets of the gnomes. Following one of these trenches we find ourselves on the edge of Pluto's Chasm, 500 feet long, 40 wide, and 70 deep, with a corresponding rift above, varying from 30 to 70 feet in height; making a total distance from top to bottom of from 100 to 140 feet.

Opposite where we stand is an alabaster formation surprisingly like a body of falling water suddenly congealed. There are many such objects in the cavern, and for want of some better term they are styled frozen or petrified cascades. On each side of this one are openings leading to a large room, to be reached perhaps at a future day by a bridge, but now by a circuitous route. The chasm is curved and its chord runs nearly S. W. to N. E. The compass was so affected by magnetic influences as not to be perfectly reliable; but

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we are satisfied of the approximate accuracy of the bearings, and Mr. Campbell assures us of their general correctness.

Following the brink of Pluto's Chasm toward the northern end we find its character changed and its bare and gloomy walls hung by fine stalactitic drapery. By burning red fire and magnesium we gained some idea of its grandeur and beauty, both above and below.

Threading our way still further amid very old and decayed pillars, we climb to a balcony inclosed by clustering columns of more modern date, and overhanging a dark and forbidding pool far below. Within this lovely balcony, which, as a compliment to the SCIENTIFIC AMERICAN, the cave owners have named for your correspondent, there are rich marvels of nature's loom. Sixteen alabaster scarfs hang side by side, of exquisite color and texture. Three are snow white; thirteen are striated like rich bands of agate, showing every imaginable shade of brown, and all are translucent. The shape of each is that of one wing of a narrow lambrequin, one edge being straight and the other meeting it by an undulating curve. The stripes follow the curve in each detail. The scarf most admired resembles a white crêpe shawl, both in size and in its graceful, wavy folds, excelling the most artistic creation of the sculptor's chisel. Down the edge of each piece of drapery trickles a tiny rill, glistening like silver in the lamplight. This is the ever-plying shuttle that weaves the fairy fabric.

(To be Continued.)

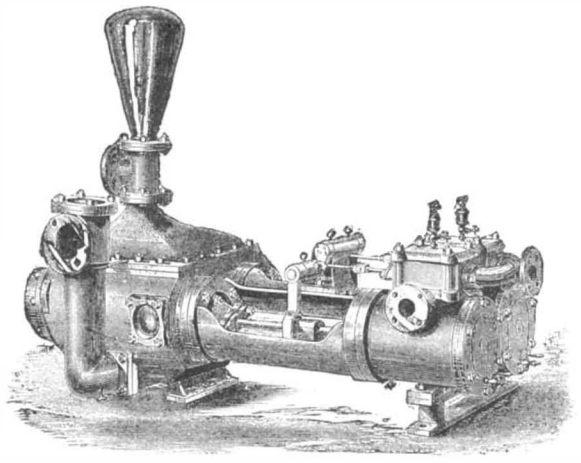
General Daniel Craig McCallum.

The necrology of 1878 contains few names of men who had served their day and country more worthily, in peace and in war, than Major-General D. C. McCallum, who died at his residence in Brooklyn, N. Y., December 27.

General McCallum was born in Scotland in January, 1815. Soon after his parents came to this country and settled in Rochester, N. Y., where young McCallum was bred to the trade of the carpenter. His attention was early directed to bridge building, at which he was notably successful. In 1851 he invented and patented the McCallum arch truss bridge, so widely introduced throughout the country. In 1855 he was appointed general superintendent of the New York and Erie Railway, but left the position two years later to superintend the construction of bridges of his design, chiefly on new roads in the West. At the same time he served as consulting engineer in the department of bridge construction for the Atlantic and Great Western Railway. When the war broke out he was called upon to serve his adopted country in connection with the transportation service, being assigned to the Department of the West, with the rank of colonel. In 1864 he was appointed general manager of all the military railroads of the United States, with the brevet rank of brigadier-general, in which capacity his splendid abilities in handling troops and supplies prepared the way for many important victories in the field. His final report on the military roads of the country, made in 1866, showed that he had had under his supervision 2,105 miles of railway, of which he had constructed 641 miles, with upward of 26 miles of bridges. On these roads there had been employed 419 locomotives and a large number of cars. The expenditure of the Government on this branch of the service exceeded $42,000,000. In June, 1865, General McCallum was mustered out of service with the brevet rank of major-general; and with the exception of a short service as inspector of the Union Pacific Railroad, has since lived for the most part in retirement. To the last General McCallum was proud of having carried the tin dinner pail of the mechanic, and of having made his way in life by hard and honest work.

DUPLEX STEAM PUMPING ENGINES.

The hydraulic works at South Brooklyn, N. Y., owned by Henry R. Worthington, the well known constructor of steam pumping machinery, are among the most extensive and complete of their class in this country. The buildings are nearly quadrangular in figure and cover an area of about 10,000 square feet, or about two city blocks. They consist, principally, of a large foundry, blacksmith, pattern, erecting and machine shops that are stocked with superior machine tools, many of which were designed and constructed for special purposes in the construction of steam pumps. At this establishment water works engines, condensing and non-condensing, of the largest size; air and circulating pumps for marine engines; stationary steam fire engines; boiler feed pumps; pumps for hydraulic pressure, and others especially adapted for oil pipe lines; water and oil meters; hydraulic cranes and hoisting machinery, etc., are constructed. Some of the larger steam pumping engines made at these works have already been described in this journal. The engraving now given represents one of the smaller description of pumps known as a duplex steam pump adapted to boiler feeding and other purposes where the service is of ordinary character. Pumps of this type have two double-acting plungers. The water valves are made of either rubber or metal. The diameter of steam cylinders ranges from 4½ to 20 inches, and that of the water plungers from 2¾ to 15 inches. The stroke varies from 4 to 15 inches. One of the most important features of the Worthington duplex steam pumping engines is the peculiar arrangement of the valve motion, which prevents all noise or concussive action. For this reason the pumps are highly suitable for hospitals, hotels, and public buildings. By reference to the engraving it will be seen that two steam pumps are placed side by side, and so combined as to act reciprocally upon the steam valves of each other. The one piston acts to give steam to the other, after which it finishes its own stroke, and waits for its valve to be acted upon before it can renew its motion. This pause allows all the water valves to seat quietly, and removes everything like harshness of motion. As one or the other of the steam valves must be always open, there can be no center or dead point. The pump is, therefore, always ready to start when steam is admitted, and is managed by the simple opening and shutting of a valve. The manufacturers state that special care has been taken to have all the parts easily accessible for inspection or repairs. All the moving parts are made to gauge, and therefore can be readily renewed.



DUPLEX STEAM PUMPING ENGINES.

The makers of this pump have adopted an excellent system of manufacture, and employ a large number of special tools, which, together with the increasing demand for their pumps, enables them to make their prices in accordance with the times.

The offices of Henry R. Worthington's Hydraulic Works are at 239 Broadway, New York, and 83 Water street, Boston, Mass.

THE CLIPPER INJECTOR.

Manufacturers of the different forms of injectors have each endeavored to accomplish some particular result—one, to feed the largest amount of water; another, to secure in

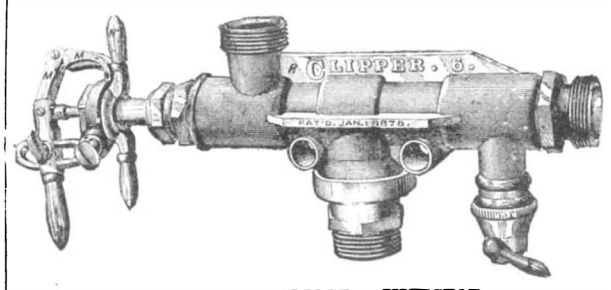


FIG. 1.—THE CLIPPER INJECTOR.

one instrument a large maximum and small minimum capacity; another gives prominence to lifting power; and still others to simplicity of construction and facility of adjustment.

The inventor of the injector shown in the accompanying engravings claims to have accomplished in one instrument all that is desirable in the perfect feeding of boilers, and states that it works at high or low pressure of steam; lifts the water, or receives it from tank or hydrant; can be regulated, without reference to steam or water valves, to feed from about one half to the full capacity; is not affected by jarring or jolting, as on a locomotive; cannot get clogged by anything entering with the water; cannot be sprung when the attachments are made; and it can be readily taken apart. The parts being made interchangeable are easily replaced, should it from any cause become necessary.

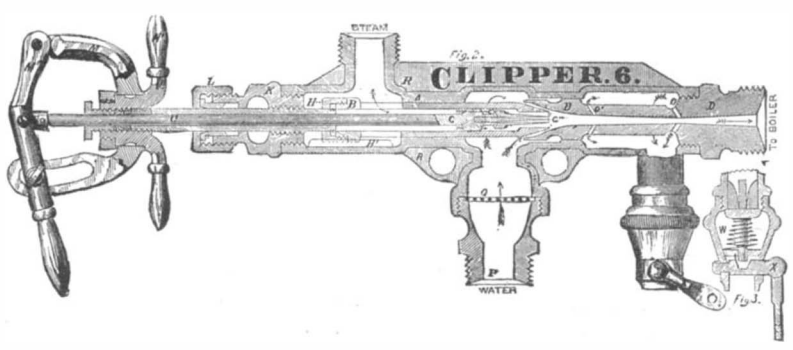


FIG. 2.—LONGITUDINAL SECTION OF INJECTOR.

The inventor says that every injector should be capable of drawing water whether it is overheated or not, without altering the adjustment. The Clipper being constructed in this way may be set so that it will feed either the maximum or minimum quantity. It is provided with a device which effectually prevents the entrance of foreign substances which might clog and impede the action of the instrument, and it is capable of working under either high or low pressure, is readily started and regulated, and is exceedingly simple and complete. The several parts are described as follows, reference being made to Fig. 2:

A is the shell, or body; B, the steam tube; C, jet, or lifting tube; D, main, or water tube; H, swivel, kept from turning by fin H'; K, bonnet, by unscrewing which, tubes, B and C, are removed; M and M', revolving lever and handle, to regulate water and steam; N', extra revolving handle, used to regulate water when room is insufficient to receive lever, M'; O, overflow holes; O', holes to assist in lifting and starting; Q, strainer, preventing anything from entering too large to go through injector; R, ribs to prevent springing or bending shell, A; W, overflow valve and spring. In Fig. 3 is shown a longitudinal section of overflow, turned one fourth round to show construction. X is the lever and revolving pin to set overflow valve when using injector to heat water in tank. A check valve is provided in connection with the swivel at the feeding end of the injector.

The injector is started by drawing the steam tube, B, back by revolving the lever and handle, M M', which turn the tube, B. The steam is fully turned on, and when it blows out at the overflow, the lever, M', is pushed forward and the water valve is opened. When the water appears at the overflow the lever, M', is pulled back and the tube, B, is moved forward slowly until no water appears at the overflow. The injector will then feed the maximum amount. It may as easily be set to feed the minimum. After adjusting in this manner it can be started without moving the lever, M'.

For further information address J. D. Lynde, patentee and manufacturer, 405 North 8th St., Philadelphia, Pa.

New Inventions.

Mr. Samuel Whitnum, of Greenpoint, N. Y., has patented a Novel Fire Shovel, having its handle and blade made in two separate pieces and connected together by a simple and strong fastening.

Mr. William Smith, of Carmi, Ill., has patented an improved Fly Trap which has an alarm mechanism in connection with a bait holder and wire gauze cone or other form of prison receptacle for flies. The alarm mechanism is operated intermittently, but at regular intervals it frightens the flies that have collected around the bait, when they ascend and pass into the prison chamber, from which they cannot escape.

Mr. Elias G. Sternberg, of Depauville, N. Y., has patented an improved Ventilator consisting of one or more perforated pipes, extending along and secured to the ceiling of a room, and provided with an outlet pipe, extending into and up through the chimney.

An improved Connector for Battery Carbons has been patented by Mr. Adam C. Kreis, of New York city. The object of this invention is to provide a connector for the carbons of batteries with the copper disks or strips that will prevent the rapid destruction of the metal attachments, which are subject to corrosion by the exciting fluid in the batteries.

Mr. Joseph H. König, of Mason City, W. Va., has patented a Process of Recovering Chloride of Sodium from its admixture with impurities in crude brine, which consists in precipitating the chloride of barium by sulphuric acid, filtering out the precipitate, then precipitating the calcium and iron together as a subcarbonate by the addition of sal soda, and afterward separating the clear liquor and crystallizing the pure salt out of solution from the bromide of magnesium.

Mr. Napoleon B. Heafer, of Bloomington, Ill., has patented an improved Kiln for burning tile, brick, pottery, or any other clay wares. It is so constructed that the heat passes directly through the wares in its upward course, and thus produces better results than it would if separated from them by a fire wall or bag, as is usual in a down draught kiln.

An improved Gas Light Extinguisher has been patented by Messrs. Philipp Brand and Edward J. King, of Jacksonville, Ill. The object of this invention is to improve the construction of the gas light extinguisher for which Letters Patent No. 206,926 were granted to the same inventors August 13, 1878, to make it simpler in construction and less expensive in manufacture, while being equally sensitive to variations in the gas pressure.

Mr. Ebenezer Miller, of Fredericton, N. B., Canada, has devised an improved Shifting Rail for carriage tops, which can readily be attached to and detached from the body of the carriage when the top is not needed. It consists of a rail provided with lugs having upper and lower lips, between which the flange or rim of the seat is clamped by thumb screws.

Mr. Henry E. Griffin, of Olympia, Washington Ter., has devised an improved Door Hinge that may be put on at a saving of screws without difficulty even by inexperienced hands, forming a cheap, neat, and strong support for the door.

Messrs. Thomas W. Platt and Arthur M. Orwig, of Windfall, Ind., has devised an improved Lifting Jack or Press Power, which is capable of exerting an immense power. It is simple and compact, and it may be used in a vertical, inclined, or horizontal position, as may be desired.

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RECENT INVENTIONS.

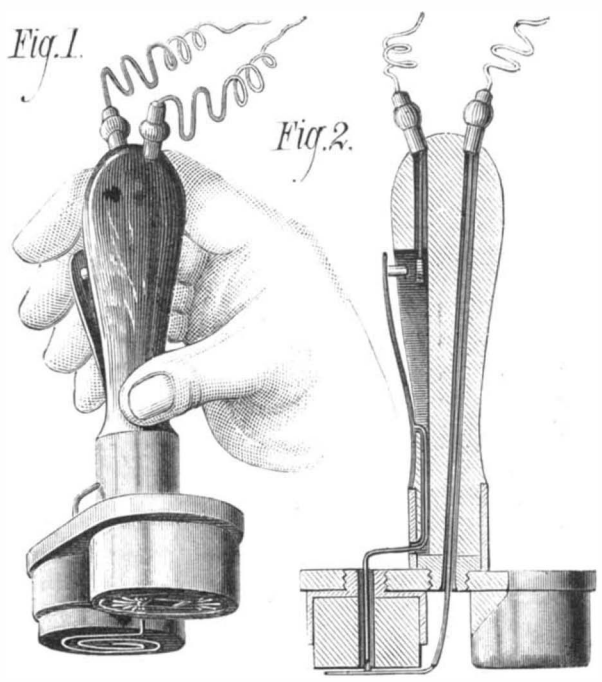
The several figures in the accompanying engraving scarcely need explanation, as the main features of the devices are shown. Figs. 1 and 2 represent a stamp canceler having on the face of one of the dies a coil of platinum wire that is heated by the passage of an electrical current. There is a key in the handle which completes the electric circuit when the instrument is grasped in the hand.

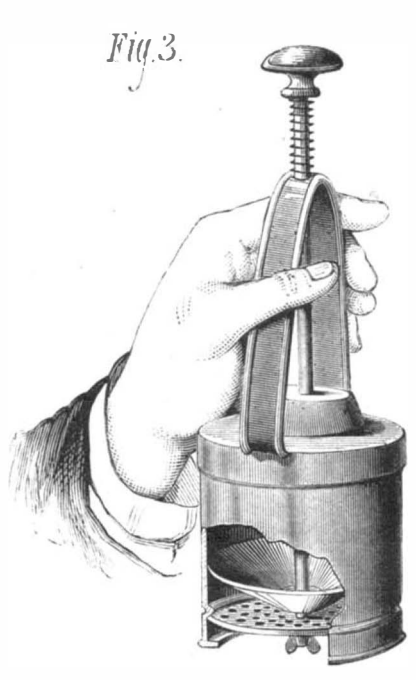
Fig. 3 represents a simple device for dusting ashes, plaster, guano, Paris green, or other pulverized substances upon plants. The substance is placed in the receptacle and passes through the aperture in the middle of the conical bottom. The sieve seen at the lower end of the receptacle is moved up and down by the handle attached to the vertical rod, when the material feeds slowly through the hole in the bottom, and is evenly distributed by the sieve.

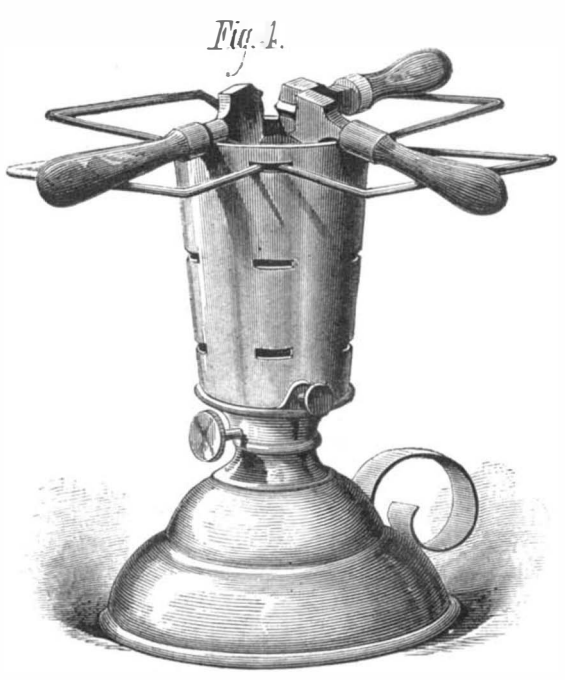
The shoemaker's lamp shown in Fig. 4 explains itself. It is designed for heating the implements used in smoothing and burnishing the edges of the soles of boots and shoes.

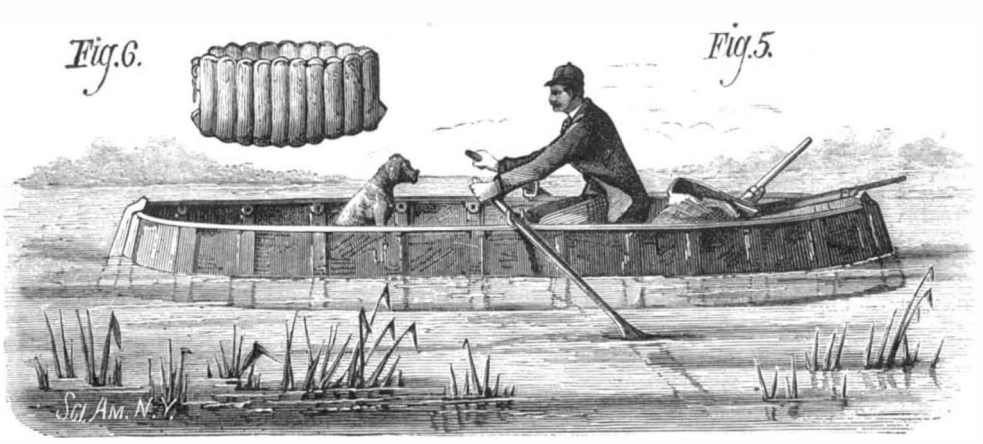
Fig. 5 represents a boat which is capable of being folded very compactly, as shown in Fig. 6. The body, or covering, consists of a skin of flexible waterproof material. The frame work is arranged so that it may be readily extended for use or folded for transportation.

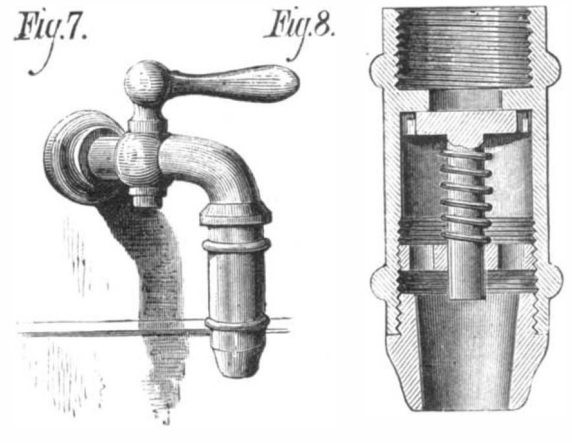
Fig. 7 shows in perspective and Fig. 8 in section a water regulator, which is designed to control the flow of water from any particular outlet, so that water may be drawn simultaneously from several outlets in the same building. This is particularly useful where the pressure or supply of water is insufficient to carry it to a higher outlet when the lower one is open. The resistance offered by the spring-acted disk may be varied by screwing up the disk upon which the spring rests.











Figs. 1 and 2. Dow's Electric Stamp Canceler.—Fig. 3. O'Brien's Plant Duster.—Fig. 4. Rosentjerna's Lamp.—Figs. 5 and 6. Osgood's Folding Boat.—Figs. 7 and 8. Hutchinson's Water Regulator.

A FEW NOVELTIES.

The Telephone in Philadelphia.

The Philadelphia Local Telegraph Company has perfected an arrangement putting their clients in the various parts of the city into immediate telephonic connection. This is done by means of an ingenious telephonic switch board recently devised. As described by a local paper, the front of the apparatus consists of a walnut frame and bright strips of brass, punctured with holes, into which wires are fitted to make the necessary connections. Behind this all the wires converging in the office concentrate. The board just put in operation accommodates no less than 400 different lines, which have an aggregate length of 1,000 miles, thus placing each firm or individual having telephonic connection with the main office in direct communication with 399 other persons scattered over the city. Should an individual at the Baldwin works desire to converse with a person at Cramp's shipyard, he ascertains from a printed card the number or call of the Kensington ship-builders. As an instance, if the number of the Cramp telephone is 12, the speaker at Baldwin's touches a spring attached to his instrument to designate the number, and immediately a bell at the central office rings out the signal, and simultaneously a little tablet on the switch board drops and reveals the name of Baldwin & Co. An attendant sees at a glance that some one at Baldwin's desires to talk with No. 12, and, finding this to be the box at the Cramp yards, connects the wires of the two places, either by means of the pins referred to or by joining them to a rod fixed in the back of the switch board. Now, the man at Baldwin's practically has his mouth to the ear of the person at Cramp's, and can talk to him about the weather, or the price of steamships, or order some machinery, or invite him to dinner, as he chooses. If he wants some article which the shipbuilder cannot supply, they may recommend him to one of the other 398 establishments connected with the telephone exchange, and, by going through the same simple process, he can order coal at Port Richmond, call for cars at Washington Street wharf, send for a man at Manayunk, and, in fact, can talk with a dozen individuals in as many distant points in less than that number of minutes. The instrument is so arranged that any number of persons can talk on as many subjects at the same time, from different points, without experiencing the difficulty that occurred at the building of the Tower of Babel.

Telephone circuits, working substantially similar to the above, are now in operation in the principal cities of the United States.

Correspondence.

A Fast Little Steam Yacht.

To the Editor of the Scientific American:

I have noticed several articles in your valuable paper in relation to steam yachts, and send you the following, hoping that you will give it room:

Last winter two boys, William and John, sons of Daniel Kelly, aged 17 and 19 years, both of them readers of the SCIENTIFIC AMERICAN, commenced work on a steam yacht, and although then at work in the shops of the Chicago and Michigan Lake Shore Railroad, they worked nights, and toward spring the work was nearly completed. John, the younger of the boys, now gave his whole time to the boat, and in April she was ready for business. She is named the Susie Watson, and is 25 feet keel, 28 feet 6 inches over all, 6 feet beam, built of oak 1 inch thick, on oak frames 1¼ inch by 1½ inch. She has an upright boiler 24 inches in diameter, 52 inches high, with 90 one inch flues; her engine is 4½ by 6; her wheel is 28 inches, 40 to 42 pitch, and with 100 pounds steam makes 300 turns per minute; she is capable of running 11 miles an hour, and has room for about 20 passengers. She has been used as a ferry on Muskegon Lake during the season, and from April 1st to December 8th made an average of 80 miles per day. This entire boat, including boiler and engine, was constructed by these boys, who are now building a much larger one for next season.

W. C. WOLVERTON.

Muskegon, Mich., December 30, 1878.

Useful and Mischievous Birds.

The State Entomologist of Illinois gives the following classification of native American birds, with regard to their capacities for use or mischief:

To be Preserved and Fostered.—Blue birds, titmice (chickadees), warblers (small warbling birds found on trees and in gardens), kinglets (ruby-crowned and golden-crowned wrens), nuthatches and creepers (black, white, and brown), wrens, martins (swallows), vireos (greenlets), tanagers, finches, song sparrow, chipping sparrow, field sparrow, clay-colored sparrow, black throated bunting, indigo bird, cardinal grosbeak, ground robin (chewink), black birds (crow, bobolinks, meadow lark, and others), all the fly-catchers (including king birds and the peewee), cuckoos, nighthawks (goat suckers and whip-poor-wills), swifts (chimney swallows), all the wood-peckers except the yellow-billed—*Sphyropicus varius*—(known in Central and Northern Illinois as the sap-sucker), and, perhaps, also the large red-headed wood-pecker—*Melaurerpes erythrocephalus*, plovers, prairie snipe (prairie plover), quail.

To be Destroyed.—Cedar bird, Baltimore oriole (hanging bird), larger owls, hawks, and the yellow-billed wood-pecker (sap-sucker of Central and Northern Illinois). This species is distinguished from the other small wood-peckers by its pale yellowish breast, a large patch of black upon the upper part of the breast; the throat of the male is a bright red, and that of the female is white; the adults, both male and female, have the top of the head also red.

Doubtful.—The following are birds whose habits are not sufficiently known to justify full recommendation, and whose habits are sometimes beneficial and sometimes injurious:

Thrushes—including the common robin, cat bird, mocking bird, brown thrasher, wood thrush, tawny thrush, and hermit thrush. Shrikes—including the great northern shrike and white rumpled shrike (butcher bird), Savanna bunting, crow, blue-jay, red-headed wood-pecker, saw-whet owl, screech owl, horned lark, orchard oriole, and pigeons.

Sulphur for Diphtheria.

Mr. John S. Wiles, a surgeon of Thorncombe, Dorset, writes to the London *Times* that after two cases of malignant diphtheria out of some nine or ten he had been called to attend had proved fatal, the mother of a sick child showed him an extract from an American paper concerning a practitioner who used sulphur to cure the disease. Accordingly he used milk of sulphur for infants and flowers of sulphur for older children and adults, brought to a creamy consistence with glycerine; dose—a teaspoonful or more, according to age, three or four times a day, swallowed slowly, and application of the same to the nostrils with a sponge. Result: he did not lose a case there or elsewhere, and he succeeded in saving life when the affection had almost blocked the throat.

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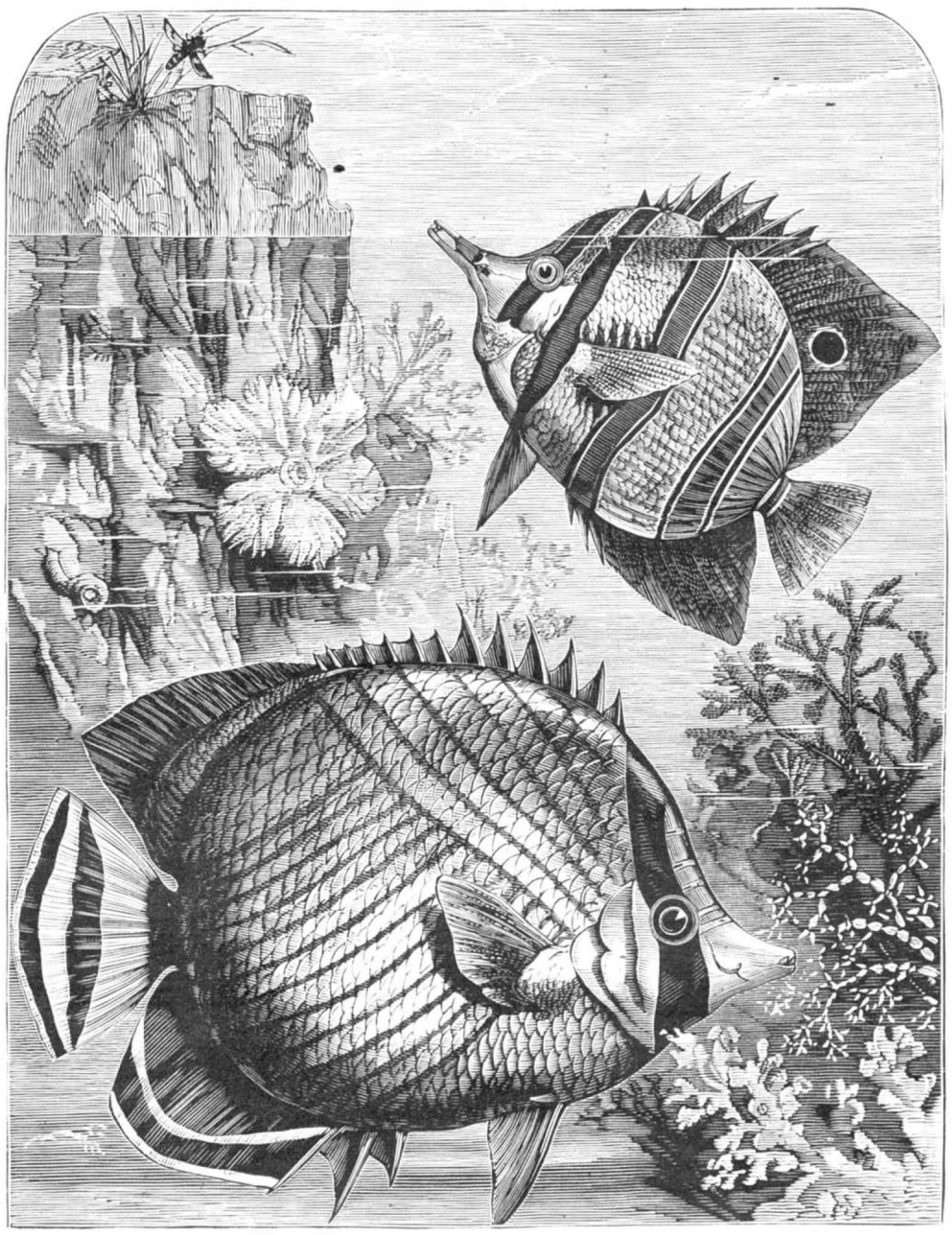
THE CHÆTODON.

The wandering chætodon is an example of a very large genus, comprising about seventy species, all of which are striking from their shape and color. Some of them are almost circular or disk like in the general contour of their figure, and the arrangement of their markings is very conspicuous. The muzzle is moderate in length, and the scales are rather large in proportion to the dimensions of the body. It is common on the southern coasts in summer and the beginning of autumn, but seems unable to endure the cold, and passes into deeper water at the first indications of winter.

The wandering chætodon is a native of the waters extending from the Red Sea to Polynesia, and is one of the common fishes of the Ceylonese coasts. The ground color of the body is golden yellow, on which a number of purplish brown lines are drawn, as shown in the engraving. This fish rarely exceeds one foot in length.

The curiously elongated muzzle of the beaked chætodon is used as a gun or bow, a drop of water taking the place of the arrow or bullet. This fish feeds largely on flies and other insects, but is not forced to depend on the accidental fall of its prey into the water. If it sees a fly or other insect resting on a twig or grass blade that overhangs the water, it approaches very gently the greater part of its body submerged, and its nose just showing itself above the surface, the point directed toward its victim; suddenly it shoots a drop of water at the fly with such accuracy of aim that the unsuspecting insect is knocked off its perch and is snapped up by the fish as soon as it touches the water.



WANDERING CHÆTODON (lower figure).—BEAKED CHÆTODON (upper figure).

A Disagreeable Discovery.

The *Commercial Bulletin*, referring to Professor Baird's astounding assertion as to the fecundity of the eel, thinks that, considering the reckless and indecent manner in which eels have lately been imposing upon manufacturing corporations—by getting into their water wheels, clogging up their machinery, and often enforcing a shut-down of the entire establishment for half a day or more at a time—manufacturers will not be pleased to hear that a well known fish culturist has discovered the number of eggs contained in a single female eel to be 9,000,000. When Professor Baird announced to the American Piscicultural Association in February last that he had, within the six weeks previous, received eels with ripe ovaries, it started a ripple of excitement in the room, which in a few days reached every naturalist in the land, and awakened new interest in the old question of the mode by which this mysterious fish perpetuated its race, one which had baffled all inquirers since man first sought to penetrate the secrets of creation, and which has almost by common consent been relegated to the category of "things which no fellow can find out." In commenting on this discovery, writers have ransacked history from Aristotle down, and have given all the theories which have been entertained by people who framed them in order to hide their ignorance, and who had not the moral courage to confess that they did not know how the fish did breed. But since the statement made by Prof. Baird, last season, many persons have been on the lookout for the ovaries of the eel, and a New York fish dealer having recently shown them to the fishermen, dealers, and others, they all say: "Oh, yes, that is what we call 'eel fat,' it is always plenty at this time of the year." And now the wonder is that no one has discovered this before, for during all these long centuries, in which the question of the generation of eels has been an open one, the eggs have been in plain sight; in fact, right under the noses of the investigators.

It may be a source of gratification to naturalists that they have solved the difficult problem, but mill owners would be glad to have them thoroughly well assured of their facts before they make the discomforting assertion that every one of the malacopterygious serpents that have this year been tampering so maliciously with the water wheels is capable of returning next season, accompanied by nine million offspring.

Natural History Notes.

Vitality of Wheat.—The seeds of the wheat possess a vitality which resists intense cold. A sample of the wheat left by the Polaris, in 1871, in 81° 16′ north latitude, and exposed to a temperature varying from that of summer to that of winter in that position for five years, was sown last year by Dr. Schanburgh, of the Botanic Gardens and Government plantations, South Australia, and out of three hundred grains, sixty germinated and produced plants, three or four feet high, with ears containing thirty grains each.

Locusts in Mid Ocean.—Psyche records the fact that a swarm of locusts boarded the ship Harrisburg, of Boston, on the passage from Bordeaux to New Orleans, on the 2d of November, 1865, in latitude 25° 28′ north, longitude 41° 33′ west, making the nearest point of land 1,200 miles away. They came on board in a heavy rain squall, the clouds and ship's sails being full of them for two days, as certified to by the master of the vessel, E. G. Wiswell. This species appeared in Corfu, in Spain, and even in England. The Corfu swarm was composed of the variety with yellow colored hind wings, and therefore came from Northern Africa, where that form is found, while the Spanish and English swarms were of the rose colored variety, and must have originated in Senegal. The most interesting point of all, however, is the fact first pointed out by Stol, that all the other species of that group of the genus to which this species belongs are American; whence it is highly probable that *Acridium peregrinum* also is indigenous to America, from whence it has been recorded. Its occurrence in mid-ocean in such numbers is a clear indication that it originally flew from one continent to the other in sufficient numbers to establish a new home.

A Hairy Water Tortoise.—Mr. Frank Buckland, in *Land and Water*, describes a curious water tortoise from China that had been presented to him. It is a terrapin which apparently has hairs growing out from its back. These apparent hairs consist simply of some water grass, something like the weedy material growing in decaying woodwork and lock gates of rivers. Whether the growth is produced artificially by the Chinese, or whether it is natural, is not known. In the "Travels of a Pioneer of Commerce, in Pigtail and Petticoats," by T. T. Cooper (London, 1871), there is a plate of one of these tortoises from the lakes of Ha-su, above Hankow. These curious little animals were about two inches long, and covered on the back with a long confervoid growth resembling hair. The tortoise being a sacred emblem in China, the Chinese make pets of the hairy tortoise, which they keep in basins during the summer months, and bury in sand during the winter. A small lake in the province of Kiang-su is famous for these so-called hairy tortoises, and many persons earn a livelihood by the sale of these curious little pets. The figure in Mr. Cooper's book looks like an oval door mat with a tortoise head sticking out. It is a well known fact that the backs of certain species of spider crabs become adorned with a luxuriant growth of algæ, which serve to conceal the defenseless animal from its enemies: may not the presence of these marine plants on the carapax of the tortoise serve a like purpose?

The Mahwa Tree.

Mr. E. Lockwood, who was for several years a magistrate in Monghyr, India, has described in the *Journal of the Linnæan Society* the economic uses of the mahwa tree, which he speaks of as "a fountain yielding food, wine, and oil" to the inhabitants of the country where it grows. This tree (the *Bassia latifolia* of botanists) grows in the plains and forests of Bengal, and attains a height of 40 to 50 feet, with numerous spreading branches, forming a close, shady, rounded crown. Standing on the Kharakpoor hills, 250 miles northwest of Calcutta, a hundred thousand of the trees are visible in the plains below. They might be mistaken for the mango, but while the mango is uncertain in its yield, the crop of the mahwa never fails. The part eaten are the flowers, which are sweet tasting and succulent, and fall in great profusion during March and April. The natives collect these, dry them, and store them as staple articles of food. Each tree yields two or three hundred weight of the corollas; so that the total yield in the Monghyr district alone, it is estimated, cannot fall short of 100,000 tons. The nourishment is good, for the Santhals, who use it largely, are plump and happy. The mahwa had its share in alleviating the Indian famine, and during the scarcity which prevailed at Behar (1873–4) the crop, which was unusually abundant, kept thousands of poor people from starvation. The flowers are still more useful for feeding cattle; and again the same recommendation may be advanced, that while the potato, maize, and barley are uncertain in their crop, there has never been a season when these edible corollas have been known to fail. Their keeping powers are excellent; a ton, dried and put into sacks, was exported, and, examined after two years' time, was found to be undamaged. The tree furnishes a hard and strong timber used for carriage wheels, etc. The seeds yield a greenish-yellow oil, used for burning in lamps, making soap, and for culinary purposes. The flowers, in addition to their use as food, are now largely employed in the distillation of a strong-smelling spirit, resembling whisky, and which is consumed in great quantities by the natives. This liquor, when fresh, proves very deleterious to Europeans. The mahwa is considered by the Bheels as essential to their very existence, and this fact is taken advantage of by the government in dealing with refractory tribes; it is only necessary to threaten the destruction of their mahwa trees to bring them to submission.

Some of the English papers believe that there is a possible commercial future for the economic products of this tree, especially for its oil, which is said to be worth $175 per ton in India.

The Supply of Boxwood.

Sir Joseph Hooker, in his last annual report on Kew Gardens, makes the following remarks on the supply of boxwood:

"For some years past the supply of this important wood has diminished in quantity and risen in price. It is derived from the forests of the Caucasus, Armenia, and the Caspian shores. The wood of the best quality comes from the Black Sea forests, and is principally shipped from the port of Poti. The produce of the Caspian forests, known in the trade as 'Persian wood,' until last year, was also exported through the Black Sea from Taganrog. This found its way, after the commencement of the war, *via* the Volga canal, to St. Petersburg. The produce of the Caspian forests is softer and inferior in quality to that of the Black Sea. It is a matter of interest to see whether one result of the war will be to open these Black Sea forests which the Russian Government has hitherto kept rigorously closed. The falling off of the supply has led, meanwhile, to various attempts to find substitutes for boxwood for many purposes. Messrs. Joseph Gardner & Sons, of Liverpool, have introduced, with some success, the American dogwood (*Cornus florida*) and persimmon (*Diospyros Virginiana*) for shuttle making, for which purpose box has hitherto been in great demand. The diminished supply has also drawn attention to the Himalayas as a source."

It seems, however, that the difficulty of transit from the mountains to the seaboard is found to be the great obstacle; and, in addition thereto, the possible supply appears to be much smaller than is furnished from existing sources. Mr. R. J. Scott has presented to the Kew Museums blocks prepared for wood engraving of hawthorn, which, he states, "is by far the best wood after box that he has had the opportunity of testing."

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Relative Earnings of Capital and Labor.

The *Tribune's* Washington correspondent gives the following report of a statement on the relations of labor and capital recently made by Mr. Edward Atkinson, of Boston, before the Committee on Labor, of which Mr. Abram S. Hewitt is chairman:

Mr. Atkinson presented interesting statistics obtained by the researches of Mr. Carroll D. Wright, chief of the Massachusetts Statistical Bureau, and from the returns of the assessors of State taxes, which, taken together, furnish as to Massachusetts (the richest State in the Union), the basis for a pretty close approximation to the truth in regard to the annual product of labor and the value of accumulated property. In 1875 the amount of property returned was as follows, values being expressed in currency, gold at the time being worth $1.10 to $1.12:

Real estate	$1,311,000,000
Personal property	530,000,000
Savings bank deposits	238,000,000
Property of corporations taxed directly by the State	84,000,000
Property returned under the bank tax,	31,000,000
Total	$2,194,000,000

On account of property subjected to double assessment, as in the case of mortgages, Mr. Atkinson deducted $650,000,000 from the returned value of real estate, and on account of mortgages, notes, and other paper merely representing titles to property, he deducted $544,000,000 from the aggregate amount of personal property assessed for taxes. This left $1,000,000,000 as the net accumulation of the actual product of labor during the two centuries which have elapsed since the Massachusetts colony was founded.

He next considered the product of industry in the State for 1875, which he set down as follows:

Manufactures	$592,000,000
Fisheries	7,500,000
Agriculture and mining	43,500,000
Total annual product	$643,000,000

In this amount, however, there were numerous duplications. Thus to some extent the same cloth is reported once as in possession of the manufacturers and again as clothing on the shelves of the dealer. After all deductions on account of duplications, Mr. Atkinson set down the net annual product of the industry of Massachusetts at a maximum of $500,000,000 or a minimum of $300,000,000, and pointed out that the aggregate accumulation out of the labor of two centuries is equal to the annual product of only two, or, at most, a little over three years.

As a partial explanation of the extreme slowness of the process of accretion, Mr. Atkinson pointed out the destructive character of invention in its effect upon existing capital. As an illustration of this he mentioned a cotton mill which in 1838 produced a given amount with the labor of 226 men working 13 hours a day, and in 1878 produces the same amount with the labor of 90 men working 10 hours a day. It belongs to the same corporation, is represented by the same shares of stock, and to all appearances is the same mill now as in 1838, but within the forty years from that date it has been twice rebuilt from the foundation, while its machinery has been again and again replaced by improved devices, devices which have increased the productiveness of labor in the degree indicated by the figures just given. This destruction of capital to make way for new inventions, said Mr. Atkinson, is the law of progress, and it is to the increase of production thus brought about that the working classes must look for the improvement of their condition.

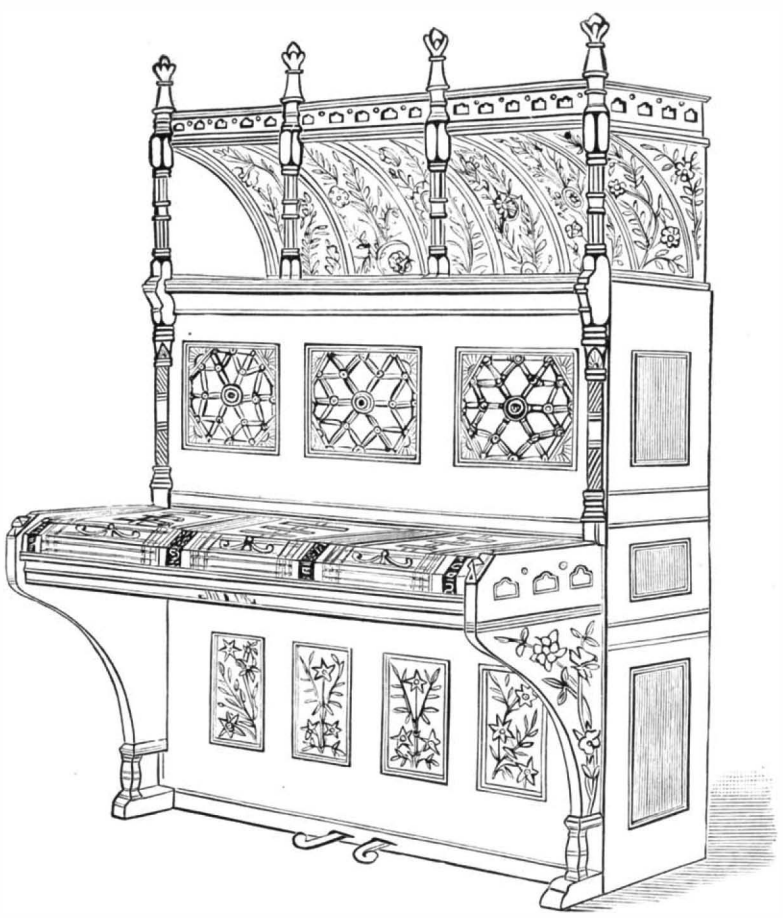
He next proceeded to show by statistics of distribution how small is the share of the annual product of industry that goes to capital, and how much smaller still is the percentage which capital can devote to luxurious uses. In a normal condition of trade, manufacturing capital may yield ten per cent. It cannot yield more, because any industry in which it yields that percentage draws so much capital into it that the profits are kept down by competition. For some years past it has yielded much less, and speaking for the cotton manufacture, it would not now be yielding anything at all except for the utilization of material formerly wasted and only saved now in consequence of services to which the wits of the manufacturers have been stimulated. Taking ten per cent as the yield of capital in ordinary times that amount has to be used to replace worn out machinery and machinery made useless by new inventions. It has also to repair building, pay insurance, and cover various other expenses, and in the aggregate the amount taken out for these several purposes reduces the ten per cent to six. Of this five per cent is used in the payment of domestic and other service employed by the capitalist and in the supply of the actual necessities of the capitalist and his family, leaving only one per cent that can possibly be devoted to the increase of capital or to luxurious indulgences.

To sum up, he declared as the result of his researches into the statistics of industry, that out of the entire annual product of industry in Massachusetts, from 95 to 98 per cent is distributed to labor, and all the remainder, except one per cent, goes to the maintenance and replacement of capital. It is out of this one per cent alone that capital can find anything to add to the percentage received by labor, and the only way in which the earnings of labor can be increased appreciably is through the increase in the efficiency of production which new mechanical inventions are continually producing.

Mr. Atkinson then went on to discuss the services which the capitalist renders to society in return for that one per cent which is the sole source of all the great fortunes made in manufactures or commerce. In reply to a question as to the present tendency of capitalists to invest in industrial enterprises, Mr. Atkinson said there is little inclination to do so, and that no improvement in this particular is to be anticipated as long as there remains any uncertainty in regard to the unit of value. He, however, anticipates a prosperous future for American industry. He disliked even to think of the difficulties in store for British industry and the distress likely to overtake the poorer classes of the British people, and he anticipated within the next five or ten years immigration from Great Britain to this country such as that which followed the Irish famine of 1846. In reply to a question from the chairman he expressed the opinion that English capital also would be transferred to this country in large amounts.

EARLY ENGLISH STYLE OF PIANO AT THE PARIS EXHIBITION.

The piano shown in the accompanying engraving is one of the exhibit of Messrs. Brinsmead, of London. It is a specimen of what this firm can do in the way of uniting beauty and novelty of exterior decoration with splendid musical effects. It is of the early English style, and is a full trichord upright iron grand, with a compass of seven octaves. It is fitted with the "perfect check repeater" action *sostenente* sounding board, and complete iron frame. The curved top part of the back is intended to act as a fenotone, collecting the sound and throwing it forward.



PIANO—EARLY ENGLISH STYLE.

Electricity in Silk Winding.

An inventor in this city claims to have perfected an electrical device which will materially reduce the cost of silk reeling, and so make the production of silk commercially profitable in this country. From their exceeding fineness the silk strands are liable to break while being unwound from the cocoons, necessitating close attention on the part of the person superintending the work. The strands of silk from four cocoons are usually run out on one reel to form a single thread, and one woman cannot do more than attend at most to two reels. It has been claimed by many interested in the silk trade that no machinery could be made delicate enough to watch this work automatically. The attention of the inventor was drawn to this subject two years ago, and he has lately perfected his application of the electric current to this work. By running the strands over carefully balanced wires, when one breaks the wire drops into mercury and closes a circuit which acts on an electric stop in the reel. The work is thus stayed until the strand is spliced and the circuit broken. In this way the electricity watches the strands, and the attendant has only to notice the reels and start them when they stop. In the old way not more than six pounds of silk could be wound in a week; by this invention it is claimed that forty pounds will be wound in the same time. The promoters of this invention hope by it to increase greatly the silk industry in this country. Owing to the cost of labor cocoons are not reeled in this country to any great extent. They are raised here—none better, it is claimed, can be found elsewhere—and exported for reeling, and then much of the raw silk is imported for manufacturing. A large amount will be saved if the cocoons can be cheaply wound off here. In the South, where the mulberry is common, it is believed that the culture of silk may rival that of cotton.

New Mechanical Inventions.

Mr. Richard H. Hill, of New Haven, Conn., has patented an improved Safety Attachment for Elevators, in which a governor is employed to throw out detents or pawls when the elevator attains an unusual speed in its descent.

An improved Railroad Track and Support has been patented by Mr. G. F. Folsom, of Boston Highlands, Mass. The object of this invention is to construct the road bed of railways so as to combine the elastic feature of wooden ties with the less perishable nature of iron. The wooden parts may be renewed without disturbing the solidity of the road bed.

Early History of the Electric Light.

A telegram from Washington, to the effect that Edison's application for a patent upon a divisible electric light had been rejected at the Patent Office, was published in the daily papers of November 21. The ground alleged for the refusal of the patent, says the *Operator*, was that Edison's invention was an infringement upon that of John W. Starr, of Cincinnati, who filed a caveat for a divisible light in 1845. [Edison's patent has since been allowed.]

Starr was a maker of philosophical instruments, and resided at Cincinnati. Had he lived he might have proved as much of a genius as Edison. He experimented on his invention, and went to England to complete it, Mr. King going as his agent, and two gentlemen, Judge J. W. McCorkle, late member of Congress from California, and Mr. P. P. Love, of Dayton, Ohio, furnished the money, about $3,000. Each was to have a fourth interest in the invention. Letters of introduction were given to King and Starr to the American banker in London, George Peabody, who, when the subject was fully explained to him, agreed to furnish all the capital that would be required to promote the project to a successful and practical use, provided that the same was approved and sanctioned by the best and most celebrated electricians in Europe. Professor Faraday was chosen.

In the meantime Starr and King returned to Manchester, where Starr built what he termed a tree, called "The United States." He had on it twenty-six branches or limbs, which he called by the names of the then twenty-six States of the Union. At the end of each limb he had an electric light, covered by a glass globe, on each of which was painted or inscribed the name of each State. Having thus completed his invention, he and King took it to London and exhibited it to the electricians at the Electrical Society, Professor Faraday being present. So perfect was his invention that the Professor pronounced it a perfect success.

After the exhibition was over King and Starr went home perfectly elated with the success, and after partaking of a very frugal meal they retired to bed. The next morning Starr, not making his appearance at the morning meal, was allowed to remain in bed, but as the day advanced and he did not make his appearance, King and the landlord went to his room, and not being able to awaken him, they burst open the door, and there found poor Starr dead in his bed. The excitement and overwork of the brain are supposed to have caused his death. From that day to this nothing further has been done with this Starr invention.

Starr filed a caveat in this country in 1845. His claim may be interesting enough to quote here:

"I claim the application of continuous metallic and carbon conductors intensely heated by the passage of a current of electricity to the purposes of illumination. I do not claim the method of lighting wires by electricity, which is well known, as I have already stated, but I claim the method of heating conductors so as to apply them to illumination, the current being regulated so as to obtain the highest degree of heat without fusing the conductor. I claim the method of obtaining an intermitting light for the use of lighthouses, in the manner set forth, and for signals. I claim the mode of submarine lighting by inclosing the apparatus in a suitable glass vessel, hermetically sealed, and also the mode of lighting places containing combustible or explosive compounds or materials, as set forth."

His application for a patent was rejected, however, in 1846, on the ground that the invention was not new, and that there was too much expense in producing the electric light. Mr. Edison says his invention is different from Starr's. He says he cannot patent the divisibility of the electric light, but he can patent the means that allows it. In other words, he can patent a lamp, or any device that will make this division. His application

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for a patent for a lamp is already before the Commissioner, and is taking its regular course. According to the rules of the Patent Office nothing concerning it can be divulged. It is understood, however, that it is progressing favorably. Mr. Edison has already received seven patents bearing on the electric light, and has filed three caveats. Five more similar applications are now under way. He has had a man in the Astor Library searching the French and English patent records and scientific journals, from the earliest dates down to the past fortnight, and says nothing like his arrangements has been revealed.

Mr. Edison is making elaborate preparations to introduce and experiment with the electric light. He purposes to commence at Menlo Park with 2,000 lights, using telegraph poles with 15 lights on each arm. This experiment, including the cost of the buildings, engine, generating machines, and everything, is estimated at from $100,000 to $125,000.

SPREADING DIPHTHERIA BY KISSES.

From the report of the physicians in attendance upon the grand ducal family of Hesse-Darmstadt during the recent outbreak of diphtheria which resulted in the death of Princess Alice, the range of the disease appears to have been sharply limited. From November 6 to the 14th six of the family were attacked; on the 6th, Princess Victoria, aged 16; in the night from the 11th to the 12th Princess Alice, aged 6; on the 12th Princess Mary, aged 4; in the night from the 12th to the 13th, Princess Irene, aged 12; in the afternoon of the 13th, the Hereditary Grand Duke Ernst Ludwig, aged 10; and on the 14th, the Grand Duke himself. Of the entire family, the Grand Duchess (Princess Alice of Great Britain) and one daughter (Princess Elizabeth) only were spared at that outbreak of the disease. The Grand Duchess, however, was attacked afterward. Immediately after the first member of the family (Princess Victoria) had fallen ill she was seen by a physician and at once separated from all the others. The same caution was observed after the falling ill of the other princesses, but without preventing the outbreak of the disease in the rest of the family. In all cases there were large patches of false membrane on the tonsils, and in most of them swelling of the lymphatic glands in the angle of the jaw. All the patients recovered with the exception of Princess Mary, in whose case the disease from its very beginning had shown a very insidious character. No member of the household (in all 60 persons), no nurse, no physician was infected. It is, therefore, clear, the British *Medical Journal* asserts, that "all the cases were produced by direct infection, doubtless by kisses." The physicians ascribe the intensity and limited extension of the epidemic to three conditions: 1. To the intensity of the infection carried from outside, because the membrane in the case of the first patient (Princess Victoria) looked from their very appearance discolored and ecchymosed; 2, to the direct transference of the infectious matter by kisses; 3, to the condition of the mucous membrane of the tonsils and of the pharynx of the infected persons, all of them having suffered very frequently from acute and chronic affection of these parts.

The lesson to be derived from this not exceptional experience is very clear.

As every physician knows, it is no uncommon thing for adults to have diphtheria so mildly that it is mistaken for an ordinary sore throat resulting from cold; yet such a person can easily infect a child, and the child become a center of malignant infection. In view of the fatal prevalence of diphtheria, therefore, the kissing of a child upon the mouth by a person with a sore throat is hazardous, if not criminal; and scarcely less so is the practice of allowing children to kiss their ailing playmates. It would be wise to exercise great caution in this matter if not to discontinue the practice of kissing upon the mouth altogether.

New Agricultural Inventions.

An improved Load Binder has been patented by Mr. Henry A. Harris, of Katonah, N. Y. This is a simple and conveniently operated apparatus substituted for the pole and chains ordinarily employed for binding hay, straw, cut grain, or bales, bundles, etc., upon a rack or wagon body.

An improved Guano Distributer has been patented by Mr. James P. Lowell, of Purcellville, Va. The improvement relates particularly to the construction of the devices both for stirring the material in the hopper, and thus preventing its becoming aggregated in lumps, and also for causing its free and uniform discharge from the hopper.

Messrs. C. A. Sprague and John W. Clardy, of Weaver's Station, Ala., have patented a Cotton Chopper and Rake in which a vibrating hoe is employed to thin out the plants.

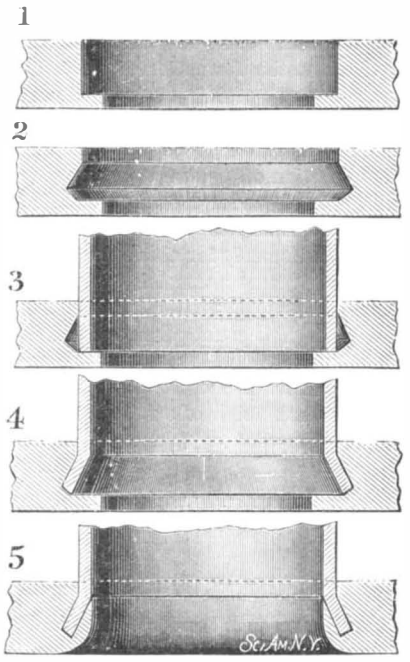
Mr. Aaron F. French, of Denison, Iowa, has patented an improved Harrow, the frame of which is fastened together by iron rods passed transversely into the ends and screwed into nuts or burrs let into the end beams. These rods serve also as draught bars, to which the whiffletrees are hooked.

An International Fish Show.

An international exhibition of the methods and products of sea and inland fisheries will be held at Berlin, Prussia, in April, 1880. Mr. R. B. Roosevelt urges the sending of exhibits from this country, confident that in several departments we could easily carry off the honors, though the Scandinavian states are far ahead of us in variety of methods of preserving fish.

A NEW METHOD OF SETTING BOILER TUBES.

We illustrate herewith a novel plan for setting tubes in steam boilers, which was recently patented by Mr. John E. Jerrold, of Meadville, Pa. The engraving exhibits the successive steps in the process of setting the tubes. Fig. 1 shows the tube sheet counterbored so as to leave an internal flange on the face side of the tube sheet. Fig. 2 shows the hole enlarged to receive the flared end of the tube. In Fig. 3 the end of the tube is in position to be flared, as shown in Fig. 4. In Fig. 5 the tube setting is shown complete, the internal flange of the tube sheet having been set down upon the flaring end of the tube.



JERROLD'S METHOD OF SETTING BOILER TUBES.

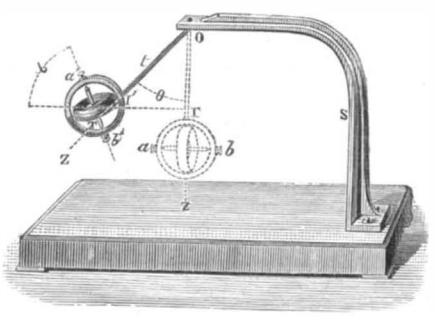
It is claimed by the inventor that a perfectly tight joint is secured without the use of an expanding tool. The surface of the tube sheet is perfectly plain and smooth, and the end of the tube is covered and protected from the fire. When this improvement is used copper thimbles will not be required.

We are informed that this method of tube setting has been thoroughly tested by some of the largest railroads in this country, and has proved very satisfactory.

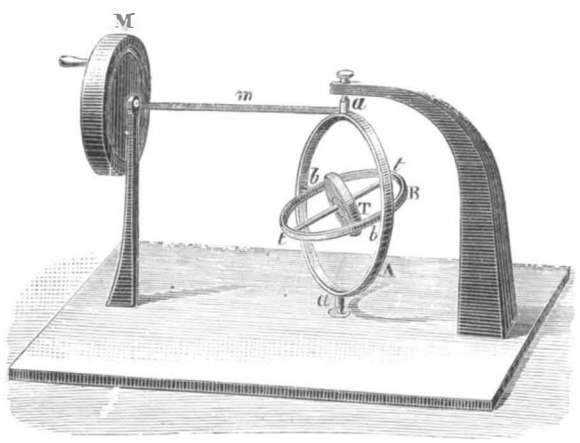
The patent is owned by the Patent Tube Setting Co., of Salamanca, N. Y. Further information may be obtained from J. F. Caldwell, secretary of the company, at Meadville, Pa.

THE GRUEY GYROSCOPE AND THE GYROSCOPIC PENDULUM.

The accompanying engravings represent two little instruments illustrating the principles involved in birotary or paradoxical motion. They were constructed by Mr. Gruey, a member of the French Academy of Sciences.



In Fig. 2, A is a brass ring suspended at *a*, so that it may swing freely around an axis, *a a*. Within this ring is suspended a second ring, B, revolving around the axis, *b b*. T is a circular disk turning with its axis, *t t*, within the second ring, B; a plane, laid through *t t*, traverses perpendicularly one laid through *b b*. At *a* the ring, A, is



connected with a rod, *m*, the other extremity of which runs smoothly in an undulating groove in the wheel, M. When the latter is turned by means of the crank an oscillating motion is imparted to the rod, *m*, and consequently to the ring, A. These oscillations are very short and unobserved by the eye; the ring, A, apparently remains at rest.

The circular disk, having received a certain initial rotary velocity, the ring, B, is struck with the finger so as to impart to it a speed of 50 revolutions per second. The speed of the ring, B, increases in the measure as the rotary motion of the disk, T, is accelerated by turning the wheel, M, more rapidly. When this operation is stopped, the apparatus gradually comes to a standstill. This simple experiment illustrates well the rotation of a body around two different axes perpendicular to each other.

Fig. 1 represents the gyroscopic pendulum. A ring similar to the ring, A, in the gyroscope, is suspended by a thread of India rubber. Within the same a circular disk revolves freely with its axis, *a' b'*. When at rest the apparatus is in the vertical position, as indicated by the engraving. If, while in this position, the thread be twisted up and again allowed to untwist, after a rotary motion has been imparted to the disk, T, by striking it with the hand, the equilibrium is at once disturbed. As the thread twists and untwists alternately the pendulum assumes an inclined position and oscillates around a conical space with wide base, till the energy of the rotary motion of the disk, T, is exhausted and the latter is at rest.—*Les Mondes.*

Petroleum Notes.

PIPE LINES.

The United Pipe Line Company was organized in 1877 by a consolidation between the following companies, viz.: The (old) United Pipe Lines, the Antwerp and Oil City Pipe Companies, the Atlantic Pipe Company, the American Transfer Company (in Clarion and Venango counties), and the Sandy Pipe Line.

At the present time (October, 1878) the company owns, and has in active operation, over 1,500 miles of 2 inch pipe, and 300 miles of 3 and 4 inch pipe. It has connected with these pipes more than 350 iron tanks, with a capacity of over 5,200,000 barrels of 42 gallons each, of which 1,800,000 barrels are owned by the company, and 3,400,000 barrels held by them under contract with the owners. It owns over 800 miles of telegraph wire connecting all its offices and stations with each other, and with the general office of the company at Oil City, Pa. It is fully equipped with boilers, pumps, and all necessary means for receiving and transporting to delivery points at least 75,000 barrels of oil per day. It has points of delivery upon all railroads in the oil regions, at which 2,500 cars, containing 225,000 barrels, can be loaded daily; and can deliver directly to refineries at Oil City, Pa.

OIL PRODUCTION.

The total production of crude petroleum, says *Stowell's Petroleum Reporter*, in Pennsylvania in November, 1878, was 1,348,952 barrels, against 1,173,420 barrels in November, 1877. Increase in 1878, 175,532 barrels.

The total amount of crude petroleum held in the producing regions of Pennsylvania December 1, 1878, was 4,289,309 barrels, against 2,471,798 barrels on the 1st day of December, 1877. Increase, 1,817,511 barrels.

The total exports of petroleum from the United States from January 1, 1878, to November 29, was 305,444,727 gallons, against 317,064,396 gallons for the same time in 1877. Decrease in 1878, 11,619,669 gallons. The Bradford district produced during the month of November, 746,279 barrels of petroleum, being about one half of the entire production in the United States.

The amount of crude petroleum represented by outstanding certificates on the last day of November was 1,784,443.35 barrels, against 1,517,484.27 barrels on the last day of October, a reduction during November of 269,959.88 barrels.

The oil produce of Pennsylvania has been to that State of more intrinsic value than all other industries combined. Its daily output of crude oil is about $500,000, varying somewhat, of course, with market values. But for all practical purposes this estimate may be taken as correct. Now, this exceeds the daily gold and silver product of the Pacific slope. We recently gave detailed statistics on this point which prove the accuracy of our present statement.—*San Francisco Post.*

KENTUCKY.—The Carter and Alexander well, which was drilled on Renox Creek, in 1865, and never tested, has recently commenced flowing oil at the rate of 100 barrels per day. The gravity of the oil is about 41° and dark brown in color.

ONTARIO.—Exports of petroleum from the United States to the Dominion of Canada during the fiscal year ending June 30, 1877:

Crude.....	270	bbls.,	valued	at	$ 2,158
Naphtha.....	83	"	"	"	795
Illuminating.....	13,224	"	"	"	187,451
Lubricating.....	1,728	"	"	"	21,959
Residuum.....	76	"	"	"	505
	15,381	"	"	"	$162,868

JAPAN.—Crude oil is obtained in ten different provinces in Japan, and its existence has been known, according to Japanese writers, since A.D. 615, but the art of purifying it was not known till some six years ago; since which time refining establishments have been erected in five different places, with a total capacity of turning out 4,000 gallons per day.

ASIA.—The valley of the Euphrates is destined to become one of the greatest commercial and important political centers of the world. I have myself seen whole caravans traveling through this region bearing nothing but American petroleum. American petroleum now lights up the dark places of Nineveh, of Jerusalem, and all the cities of the East.—*Lecture by Dr. Newman.*

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Recent Facts about Poisons.

CARBOLIC ACID.

According to the *Pharmaceut. Zeitung für Russl.*, Dr. Sanftleben, on the recommendation of Professor Baumann, has used sulphuric acid with the best success as an antidote to carbolic acid, the phenol combining with the acid to form phenyl sulphuric acid, which is not poisonous. He administers it in a mixture composed of diluted sulphuric acid 10 grammes, mucilage of gum arabic 200 grammes, and simple sirup 30 grammes, in doses of a tablespoonful every hour.

POISONING BY MOULDY BREAD.

An inquest was held at Barnsley, England, October 10, in relation to the deaths of two of eight persons poisoned by partaking of bread pudding made at the Albert Dining Rooms, Barnsley. A. H. Allen, public analyst, testified that he had examined the liver and kidney of one of the victims, and the liver and lungs of the other, without finding any trace of poisonous metal. The materials used in making the pudding had been carefully examined with negative results. The glaze of the basin in which the pudding was cooked had been found to be free from lead or other poisonous metals. The pudding had been very carefully examined and no deadly poison had been detected. The negative results of the chemical examinations for various metallic poisons had been borne out by the failure of either pudding to produce purging or other poisonous effects on a puppy which was fed on the suspected pudding for two whole days. There were not a few cases on record of irritant poisoning and death being produced by mouldy bread. Thus, horses have been killed in a short space of time after eating such bread in their ordinary food. The symptoms were those of an irritant poison. In 1829 an investigation was made in France into the cause of illness due to eating bread, and it was found, by experiment, that bread in a particular state of mouldiness or decay may not only produce symptoms of poisoning, but actually cause death; and it was impossible to distinguish the harmless from the dangerous kinds of mould. As fungi grow very rapidly, it is quite possible for mouldy bread to be quite poisonous at one date, and to have lost its poisonous properties two days afterward. One of the most poisonous of these fungi is ergot, which produces symptoms very similar to those occasioned by the pudding, and the reports of the evidence in the present case have caused an eminent toxicologist to express a very strong opinion that the presence of this fungus was the cause of the poisoning. The witness stated further, that from experiments and observations he thought it clearly shown that the pudding contained a substance which resembled ergot in all its chemical reactions. The pudding was made of bread said to be mouldy, and which was several weeks old and had been in contact with ham, butter, and miscellaneous scraps. Mr. Allen then submitted extracts of letters from the leading toxicologists of the kingdom whom he had consulted on the subject, and all of whom agreed with him in his opinions as set forth above.

OPIUM POISONING.

Dr. Sewall, in the *Medical Press and Circular*, relates the case of a woman, aged 35 years, who, suffering from angina pectoris, took 2 drachms of Battley's sedative at intervals of half an hour until she became insensible; taking in all, according to estimate, 3½ fluid ounces. A convulsion and marked symptoms of opium poisoning supervened. An enema of ½ pint of strong green tea was given, and in twenty-five minutes her lips became more florid, and respirations from thrice in two minutes to six times a minute. Fifteen minutes later ½ pint more of tea was given in the same way. In 4½ hours patient recovered consciousness.

PHOSPHORUS.

Two girls, aged 14 and 16, according to Dr. Wilmore, in the *British Medical Journal*, took ½ ounce of phosphorus paste. The subacute symptoms lasted for five days before the relatives became alarmed. Neither pain nor vomiting was severe. One patient died; the other (who took the least) recovered. Turpentine was administered through the latter case.

SALICYLIC ACID.

A case is reported from Wreschen, in Prussia, where a patient suffering from acute rheumatism was poisoned by impure and partially decomposed salicylic acid. After the dose of about 12 grains he began to perspire very freely; the perspiration increased with two more succeeding doses, and after the fourth dose violent headache supervened, followed by coma and death.

THE POISON OF MILK SICKNESS.

This is one of the most remarkable and subtle poisons known. All attempts to fix it on certain plants or elements of soil or water have failed. Yet it is of the most permanent and virulent character. The following illustration of this is given by a writer in the North Carolina *Medical Journal:*

"Captain Thompson lost thirteen of his cattle from milk sickness as he was driving them from the Milestone Knob (a noted place for the disease). He had them skinned, and the hides were hung on poles between his cribs; the rats being numerous, they gnawed the cellular substance from the hides, which was so poisonous as to kill every rat about the cribs." He adds: "This poison differs from all known poisons in the world, in the following particulars: (1) It lies quietly in the system for a long time, without exhibiting any of its toxical power, until the person or beast is forced to take exercise; (2) it is more ethereal and diffusive than any poison known to me. Most of the poisons with which I am acquainted affect the stomach and bowels, the brain and nervous system; this pays no court to either, but extends through every muscle, bone, and tendon, affecting the whole system, even the skin and cellular substance under the skin."

The Treatment of Baldness.

In the Atlanta *Medical and Surgical Journal*, Dr. George H. Rohe writes on this widely interesting subject:

Having been himself a sufferer from seborrhea and consequent alopecia for six or seven years, the writer has, as may be supposed, tried a great many remedies with a view to its alleviation and cure. Arsenic, internally, stimulating washes or oily applications, containing in the one case corrosive sublimate, in the other quinine or tannin, in still another some of the stimulating oils, were used with no appreciable effect either on the formation of scales or the depilation. Finally, about two years ago, an item went the rounds of the medical journals to the effect that a French physician, whose name has escaped me, had found that the local use of a five per cent solution of chloral hydrate was a sovereign remedy for the trouble under consideration. Rejoiced that at last I could appropriately shout "Eureka!" I began to use the chloral wash assiduously for about three months, following the directions given as accurately as possible. At the end of the three months the production of scales was more rapid and the fall of hair greater than ever. Disgusted with the failure of all the therapeutic measures which had been so highly lauded, I almost decided to let the affection take its own course, and run the risk of a shiny bald pate at thirty. About that time the second volume of Hebra's classical treatise on diseases of the skin came to hand, and one of the first things I read was Kaposi's thorough article on alopecia. Impressed with the reasonableness of the views put forth by Kaposi, I determined to give his plan of treatment a trial, with the result of checking the fall of hair and diminishing the production of scales in a reasonably short space of time. I have since then recommended the plan in a considerable number of instances, and when it has been faithfully carried out, with uniform success.

The success of the method depends upon the use of an agent which, while mildly stimulant, removes the scales and thoroughly cleanses the scalp. This agent is the German or French soft soap (green soap, schmierseife, savon vert) in alcoholic solution. This soap is now imported in large quantities and prescribed daily by the dermatologists of Boston, New York, Baltimore, Philadelphia, and other cities. The soap, containing an excess of alkali, saponifies the fatty matter of the sebaceous secretion, and it is thus easily removed. The alcohol greatly assists this action, and seems also to have an alterative action—if such an indefinite term is excusable—on the glands. The two may be combined as follows.

R. Saponis viridis (Germ.); alcoholis, āā, ℥ ij.; solve, filtra, et adde ol. lavandulæ gtt. xx.–xxx.

The oil of lavender is added to cover the disagreeable fishy odor of the soap. The above makes a very handsome orange or wine colored preparation, with a pleasant odor, to which the most fastidious will hardly object.

This is used as a shampoo every morning or evening, pouring one or two tablespoonfuls on the head. Upon the addition of water, and smart friction with the fingers, a copious lather is soon produced. After keeping up the shampooing process for four or five minutes, all the soap must be washed out of the hair by the free use of warm or cold water, and the hair thoroughly dried by means of gentle friction with a soft towel. The immediate effect experienced is a disagreeable feeling of tension of the scalp, as if it were stretched too tightly over the skull. To obviate this effect, and to keep the scalp from getting too dry, and thus, perhaps, set up a true pityriasis, it is necessary to follow up the shampooing with some fatty application, which may contain some mild stimulant, thus: Castor oil, 1 part, to alcohol 3 or 4 parts, with a little oil of rosemary or cinnamon, or the elegant pomades and oils of Bazin and other manufacturers may be used. But the best as well as the neatest preparation that I have employed for this purpose is the hydrocarbon known in commerce as cosmoline. This is a product obtained from petroleum. It is entirely bland and unirritating; never turns rancid, and is comparatively cheap. It may be obtained in the fluid form or as a soft solid.

This procedure, shampooing, drying the hair, and applying the greasy preparation, must be repeated daily for three or four weeks. In the course of that time it will be discovered that the production of scales and the falling of the hair have been very markedly decreased. It will then suffice to repeat it two or three times a week for a month or two longer, after which a good shampoo once a week will usually succeed in maintaining a permanent cure.

Most patients will be alarmed after using this method at first, because the hair comes out in greater quantity than before. This is due to the fact that a large number of hairs are dead and only retained in their follicles by the plugging of the sheath with the accumulated sebaceous matter. The patient should, therefore, always be prepared for this result, and the cause of the increased falling of the hair explained to him.

It is not necessary, though more convenient, to cut the hair short during the treatment.

When the alopecia has lasted so long that the hair bulbs have become atrophied, nothing will restore the hair on those spots. Our endeavors must be directed to saving what remains. A prognosis favorable to the restoration of the hair must, therefore, be given with caution.

Microscopic Examination of Meat.

The microscope is, in many places, relied upon to decide upon the presence or absence of trichinæ in pork, but unfortunately, it often happens that a poor microscope or an inexperienced or careless manipulator fails to detect what is actually present, and by giving a feeling of false security does positive injury. This, too, has caused many to reject the microscopic test as useless.

The failure to detect trichinæ may, and often does, occur as the result of using too small pieces of meat for examination, rather than from inexperience, so that it is mere chance that this little scrap contains the object looked for. This is partially the fault of the books published for instruction in this subject, such as Wolf's and Lang's. Sometimes very few trichinæ are present, "few and far between." Recently an apothecary, Schaltz in Primkenau, examined twelve plates, each holding 6 pieces of meat, or 72 preparations, but found only 2 trichinæ. Tiemann demands the examination of at least 22 square inches of the substance, and introduces large glasses for this purpose, but it is very hazardous to bring very large surfaces under the microscope, and it is easy to overlook small objects, if few.

Kunstmann says that he has experimented with glasses 2 to 3 millimeters thick, of various sizes and shapes, in which the meat is held by screw clamps. At last he chose plate glass 6 or 8 millimeters thick. The power used for the examination of meat is so low and permits of so great a distance from the objective that both object glass and cover may be of the same thickness. For two years he has employed strips of plate glass 5 cm. (2 inches) wide and 40 cm. (16 inches) long, which fit accurately on each other. On one of these he puts the piece of flesh, cut with a curved scissors, spreads it out uniformly with a needle, and squeezes it between the two glasses, so that he has an unbroken preparation 2 cm. wide and 36 cm. long. Between these glasses the preparation lies fast without the use of any further pressure. This glass is passed lengthwise through under the objective, one edge being examined first and then the other, then the middle, no portion escaping. Glasses of this size can be employed with an objective that magnifies 60 diameters.

The same man, also, sometimes employs plates of glass 70 cm. (28 inches) long, but they require a special table, and can only be used in the laboratory or at home. It may seem a paradox to use such large glasses for microscopy, yet no other method offers such security. The meat examiner is compelled to examine the whole preparation, and only by the greatest carelessness can any trichinæ be overlooked. These long strips of glass can be obtained from the waste box at mirror manufacturers.

Another important point overlooked in most treatises on the subject is that the microscope must be placed high enough to look into it without bending the neck, which also leaves the hands in a more natural position to regulate the glass plate. A convenient cover for one eye is also desirable to avoid being obliged to hold it shut.

Two Varieties of Sciatica.

There are two varieties of sciatica, one in which the nutrition of the limb is unchanged, the other accompanied by atrophy of the limb. In the first class the neurilemma alone is affected; in the second, the nerve fibers are attacked by the inflammation and cause atrophy of the limb. There are two kinds of pain, one only present on motion of the limb, the other when the limb is at rest. In all cases the first element of cure is rest. To this in cases of the first class must be added blisters and hypodermic injections. The pain being allayed, dry fumigations should be used. Dry heat is better than douches of sulphurous or terebinthinate vapors. In default of the former, vapor douches give the best results.—*L'Union Médicale du Canada.*

Oatmeal Diet.

Undoubtedly one of the most healthful and nourishing articles of diet is oatmeal. When properly cooked and eaten with sugar and cream it forms a dish which most people relish better than meat for breakfast, and is very much cheaper. Liebig has chemically demonstrated that oatmeal is almost as nutritious as the very best English beef, and that it is richer than wheaten bread in the elements that go to form bone and muscle. Professor Forbes, of Edinburgh, during some twenty years, measured the breadth and height, and also tested the strength of both arms and loins, of the students of the University—a very numerous class and of various nationalities, drawn to Edinburgh by the fame of his teaching. He found that in height, breadth of chest and shoulders, and strength of arms and loins, the Belgians were at the bottom of the list; a little above them the English; and highest of all the Scotch, and Scotch-Irish from Ulster, who, like the natives of Scotland, are fed in their early years at least one meal a day of good oatmeal porridge.

Moral Influences of the Study of Natural Science.

If great care is taken to bring out the evidence in every case, and no statements are permitted to pass unquestioned which have not been tested by observation or experiment, a great respect will gradually arise for the truth. I believe that a conscientious regard for the truth may be established in this way without that word itself ever having been mentioned. Accuracy in observation and moderation of statement, are certainly the surest guardians, if not the keepers of truth, and these two qualities are more easily obtained by the study of objects than by any other means.—*Alpheus Hyatt.*

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TO INVENTORS.

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Assays of Ores, Analyses of Minerals, Waters, Commercial Articles, etc. Technical formulæ and processes. Fuller & Stillman, 40 & 42 Broadway, N. Y.

Save your Fuel.—From one fifth to one-third of the usual amount of coal bills can be saved by the use of fireproof non-conducting Asbestos Coverings on hot air and steam pipes, boilers, heater pipes in dwellings, etc. The genuine can be procured only of The H. W. Johns Manufacturing Company, 87 Maiden Lane, New York, patentees and manufacturers of Asbestos Paints, Roofing, etc.

2d hand 2 H. P. Engine and Boiler, $140. Geo. F. Shedd, Waltham, Mass.

For Solid Wrought Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, etc.

Moore's Regulating Valve, working between high and low pressure. L. Moore, No. 17 11th St., Louisville, Ky.

Dead Pulleys that stop the running of loose pulleys and their belts, controlled from any point. Send for catalogue. Taper Sleeve Pulley Works, Erie, Pa.

Sci. Am.; a full set for sale. A. F. Park, Troy, N. Y.

Steel Stamping Fgures, 1-16 to ½ in., $1; Alphabets, $3; Dies to order. S. M. York, Cleveland, O.

Presses, Dies, and Tools for working Sheet Metal, etc. Fruit & other can tools. Bliss & Williams, B'klyn, N. Y.

Partner Wanted.—See advertisement on inside page.

The only Engine in the market attached to boiler having cold bearings. F. F. & A. B. Landis, Lancaster, Pa.

Blk's, Mech's, Ma'fs., address Box 73, Willimantic, Ct.

Johnson's Universal Lathe Chucks; the best are the cheapest. Lambertville Iron Works, Lambertville, N. J.

No more danger from kerosene. Sample of patent Safety Valve that fits any lamp, and effectually prevents an explosion, sent by mail for 25 cents. Agents wanted. W. B. Post, 15 Dey St., New York.

Best results obtained from Success Turbine Water Wheel. References given. S. M. Smith, York, Pa.

Right to manufacture a salable Patented Article desired. W. F. Adams, 602 North 4th St., Camden, N. J.

For Sale.—Brown & Sharp Universal Milling Machine; Bement Profiling Machine; first-class 2d hand Machine Tools. E. P. Bullard, 14 Dey St., N. Y.

Texas Machinery Depot for any kind of machinery or special hardware. P. H. Gerhard, Austin, Texas.

Send for circulars of Indestructible Boot and Shoe Soles to H. C. Goodrich, 40 Hoyne Ave., Chicago, Ill.

Nickel Plating.—A white deposit guaranteed by using our material. Condit, Hanson & Van Winkle, Newark, N.J.

1,000 2d hand machines for sale. Send stamp for descriptive price list. Forsaith & Co., Manchester, N. H.

Galland & Co.'s improved Hydraulic Elevators. Office 206 Broadway, N. Y., (Evening Post Building, room 22.)

Iron, Brass, and Steel Wire. Needle pointed English Steel Wire, for all purposes. W. Crabb, Newark, N. J.

For Fire or Power Pumps, address the Gould's Manf. Co., Seneca Falls, N. Y., or 15 Park Pl., N. Y. city.

Brush Electric Light.—20 lights from one machine. Latest & best light. Telegraph Supply Co., Cleveland, O.

The Hancock Inspirator received a gold medal at Paris, as being the best boiler feeder ever made, and the Old Colony Railroad (who have twenty-three machines in constant use) have just given it their unqualified indorsement, as the cheapest and most effective feeder ever used on their locomotives. Those interested are referred to their letter of recommendation, which may be found in our advertising columns.

J. C. Hoadley, Consulting Engineer and Mechanical and Scientific Expert, Lawrence, Mass.

The Lathes, Planers, Drills, and other Tools, new and second-hand, of the Wood & Light Machine Company, Worcester, are to be sold out very low by the George Place Machinery Agency, 121 Chambers St., New York.

For the best advertising at lowest prices in Scientific, Mechanical, and other Newspapers, write to E. N. Freshman & Bros., Advertising Agents, 186 W. 4th St., Cin., O.

H. Prentiss & Co., 14 Dey St., N. Y., Manufs. Taps, Dies, Screw Plates, Reamers, etc. Send for list.

Hydraulic Elevators for private houses, hotels, and public buildings. Burdon Iron Works, Brooklyn, N. Y.

Bolt Forging Machine & Power Hammers a specialty. Send for circulars. Forsaith & Co., Manchester, N. H.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, N. Y.

Eagle Anvils, 9 cents per pound. Fully warranted.

Bevins & Co.'s Hydraulic Elevator. Great power, simplicity, safety, economy, durability. 94 Liberty St. N.Y.

Manufacturers of Improved Goods who desire to build up a lucrative foreign trade, will do well to insert a well displayed advertisement in the SCIENTIFIC AMERICAN Export Edition. This paper has a very large foreign circulation.

Two fine Astronomical Telescopes, 3 in. and 7 in., by first-class English maker, cheap. I. Ramsden, Phila.

Gold Chronometer Watch, by first-class English maker; cost $260, price $135; latest patented improvements. I. Ramsden, 21 Christian St., Philadelphia, Pa.

For Town and Village use, comb'd Hand Fire Engine & Hose Carriage, $350. Forsaith & Co., Manchester, N. H.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon & Co., 470 Grand St., N. Y.

Inventors' Models. John Ruthven, Cincinnati, O.

Sheet Metal Presses, Ferracute Co., Bridgeton, N. J.

Warranted best and cheapest Planers, Jointers, Universal Woodworkers, Band and Scroll Saws, etc., manufactured by Bentel, Margedant & Co., Hamilton, Ohio.

Mill Stone Dressing Diamonds. Simple, effective, and durable. J. Dickinson, 64 Nassau St., N. Y.

The best Friction Clutch Pulley and Friction Hoisting Machinery in the world. D. Frisbie & Co., N. Haven, Ct.

Latest and best Books on Steam Engineering. Send stamp for catalogue. F. Keppy, Bridgeport, Conn.

Improved Meat Cutter. Capacity 600 lbs. an hour. Circular and price list, J. W. McFarland & Co., Alliance, O.

Cutters shaped entirely by machinery for cutting teeth of gear wheels. Pratt & Whitney Co., Hartford, Conn.

Hydraulic Cylinders, Wheels, and Pinions, Machinery Castings; all kinds; strong and durable; and easily worked. Tensile strength not less than 65,000 lbs. to square in. Pittsburgh Steel Casting Co., Pittsburgh, Pa.

The new "Otto" Silent Gas Engine is simple in construction, easy of management, and the cheapest motor known for intermittent work. Schleicher, Schumm & Co., Philadelphia, Pa.

Vertical & Yacht Engines. N.W. Twiss, New Haven, Ct.

Pulverizing Mills for all hard substances and grinding purposes. Walker Bros. & Co., 23d & Wood St., Phila., Pa.

Correct thing for Holidays, Whist and Dinner Parties, is the Vanity Fair Cigarettes, with your monogram.

The SCIENTIFIC AMERICAN Export Edition is published monthly, about the 15th of each month. Every number comprises most of the plates of the four preceding weekly numbers of the SCIENTIFIC AMERICAN, with other appropriate contents, business announcements, etc. It forms a large and splendid periodical of nearly one hundred quarto pages, each number illustrated with about one hundred engravings. It is a complete record of American progress in the arts.

NEW BOOKS AND PUBLICATIONS.

UPLAND GAME BIRDS AND WATERFOWL OF THE UNITED STATES. Part X. By A. Pope, Jr. New York: Charles Scribner's Sons. $2.50.

The tenth and final number of Mr. Pope's illustrations of the principal Upland Game Birds and Waterfowl of the United States is devoted to the canvas back duck and the brant. The entire series comprises life size drawings in color of twenty species, male and female, or forty specimens in all, by an artist sportsman who has given to them years of patient and painstaking study. The printing reproduces the artist's water color effects admirably.

HAND BOOK OF ALABAMA. By Saffold Berney. Mobile: *Register* Print. $1.50.

A useful volume for those seeking information with regard to the government institutions and resources of Alabama. The State Geologist, Dr. E. A. Smith, contributes a valuable section on the geology of the State and its mineral resources (with a revision of Professor Tuomey's Geological Map of the State), and Mr. Haralson a review of the cotton manufactures of the State and its advantaegs for such industries. Parts X., XI., XII., and XIII., are devoted to the agricultural products, soils, capabilities, advantages, forest and forage products of Alabama. A report on the climate of Alabama and its adaptation to health and comfort is contributed by Professor William H. Anderson, of the State Medical College, Mobile.

HYGIENE OF THE BRAIN AND NERVES. By M. L. Holbrook, M.D. New York: M. L. Holbrook & Co.

A book of exceptional value; sensible, timely, practical; indeed one of the very few books that everybody should read. It discusses with singular directness and intelligence one of the most dangerous features of American life, high pressure activity, and unwise eating and drinking, combined with a fatal anxiety to accomplish in one year more than there is time for in two; an anxiety, we may add, which makes life at once brief, hurried, fretful, and unenjoyable, with the result in most cases of early nervous breakdown and practical life failure. If read and heeded, as it ought to be, the volume in hand will do much to correct this characteristic mistake in American life. The strong positions taken by Dr. Holbrook with regard to proper habits of eating, sleeping, working, and playing, are fortified by citations from the writings of a score or more of prominent thinkers and scientists, and twenty-eight letters from prominent men and women, describing their physical and mental habits, and giving practical deductions from their personal experience.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION FOR 1877. Washington: Government Printing Office.

In addition to the customary review of scientific work carried on under the auspices of or assisted by the Smithsonian Institution, this volume is enriched by an able review of color blindness in its relation to accidents by rail and sea, by Professor Holmgren, of the University of Upsal, Sweden; a large number of valuable communications on American antiquities; a dozen short memoirs on meteorological subjects, and other papers of permanent interest.

THE YOUNG SCIENTIST. Industrial Publication Company. New York: 50 cents a year.

A monthly journal for boys, devoted to simple experiments in chemistry, amateur mechanical work, etc.

CATALOGUE OF THE LIBRARY OF THE UNITED STATES PATENT OFFICE. Washington: Government Printing Office.

This is substantially the first printed catalogue of the Patent Office Library, which now contains some 24,000 volumes, not including duplicate specifications of patents and pamphlets.

THE AMERICAN QUARTERLY MICROSCOPICAL JOURNAL. Vol. I. No. 1. Edited by Romyn Hitchcock. New York: Hitchcock & Wall. $3 a year.

In view of the numerous failures of high grade periodicals in this and other special departments of science, the projectors of this handsome quarterly are to be commended for courage, if for nothing more. The initial number is highly creditable to them and to their department of scientific research. We sincerely hope that it will be well sustained.

MANUAL OF MINERALOGY AND LITHOLOGY. By James D. Dana. New York: John Wiley & Sons.

This, the third edition of Professor Dana's useful manual, is almost a new book throughout. It has been rearranged and rewritten, and, the author believes, materially improved. The chapter on rocks has been increased in fullness so as to make it a prominent part of the work.

JOURNAL OF THE BRITISH SOCIETY OF TELEGRAPHIC ENGINEERS. Nos. XXII. and XXIII. London and New York: E. & F. N. Spon. 1878. 15 shillings.

Contains, in addition to brief communications, correspondence, abstracts, etc., a valuable paper on "Insulators for Aerial Telegraph Lines," by John Garvey; and several papers and discussions on sound in relation to the telephone, microphone, etc.

THE MAGAZINE OF ART. Illustrated. New York: Cassell, Petter & Galpin. $3 a year.

Among the more attractive periodicals that have come to our table the past year the *Magazine of Art* must take high rank. The eighth number of the first volume was reached in December, and there is every reason to wish it a long life as a representative of fine art.

ART INDUSTRY. New York: Howard Lockwood & Co. $2 a year.

Of *Art Industry* but three numbers have been issued, and these have given promise of future usefulness. It is specially devoted to the artistic industries and is finely illustrated. The reading matter is readable and instructive.

BULLETIN OF THE UNITED STATES NATIONAL MUSEUM.

We have received from the Department of the Interior the following issues of the Bulletin of the United States National Museum:

No. 7. Contributions to the Natural History of the Hawaiian and Fanning Islands and Lower California. By Thomas H. Street, M. D.

No. 8. Index to the names which have been applied to the subdivisions of the class Brachipoda. By W. H. Dall.

No. 9. Contributions to North American Ichthyology. No. 1. By David S. Jordan.

No. 10. The same. Part II.

No. 12. The Same. Part III.

Also recent issues of the Bulletin of the United States Geological Surveys of the Territories:

Vol. III., No. 4; and Vol. IV., Nos. 1, 2, and 3. Also, miscellaneous publications:

No. 9. Descriptive Catalogue of Photographs of North American Indians. By W. H. Jackson; and No. 10. Bibliography of North American Invertebrate Palæontology. By C. A. White, M.D., and H. A. Nicholson, M.D.

PHOTOGRAPHS OF THE MOON.—It is fortunate at this time of increasing interest in the moon that arrangements have been made for supplying cheaply and in any quantity Mr. Rutherfurd's splendid photographs of that satellite. Mr. Oscar G. Mason, of the Photographic Department of Bellevue Hospital, of this city, has undertaken the publication of these valuable aids to the study of the moon, at rates which bring them within the reach of all; and as he has not only made all the prints hitherto furnished, but assisted Mr. Rutherfurd in making the negatives, there can be no doubt of his doing the work well. Three series of prints are offered, the first showing the different phases of the moon, in dimensions ranging from 17½ to 21 inches; the second series, nine views, eight inch image; the third, nine views, four inch image.

Mr. Mason is also prepared to furnish prints from Mr. Rutherfurd's negatives of the solar spectrum, recently made with his interference gratings. The prints from these plates give the finest picture of the solar spectrum yet produced.

SOME AMERICAN MAGAZINES.

Scribner's Monthly, which began by rivaling the best popular magazines of the time, has steadily gained in force and excellence. The later volumes not only surpass the earlier, but their steady improvement, especially in the matter of illustration, has compelled a corresponding advance in the quality of American art work, both for books and for periodicals. A host of attractions are announced for the new year.

St. Nicholas has no rival. Its bright and seductive pages furnish more that is calculated to cultivate in the young a taste for pure and instructive reading, and with it a taste for all that is true and clean and kindly in life and conduct, than anything else we know. And it is admirably free from the goody-goody stuff so commonly manufactured for children's reading. It is needless to add that it is absolutely free from the other extreme of juvenile literature—the viciously sensational.

The *Popular Science Monthly* promises to add to its solid attractions, and they are numerous, the merits of the *Popular Science Supplement* also, a magazine which has been in many respects the more solidly valuable of the two. In other words, the *Monthly* is to be enlarged, so as to make it represent the scientific field more completely, by absorbing the *Supplement*, but without any increase in its price. This will be especially gratifying to those who have wanted both publications, yet have felt unable to afford the cost of the two.

The removal of the *North American Review* to New York, and the change of plan in making it more alive to timely questions of public moment and their discussion by men of experience and practical information, rather than by closet students, have added much to its force and value; certainly to the mass of active men who care more to know what prominent men are thinking about matters of general interest, than for the lucubrations of pure scholarship.

Notes & Queries

(1) C. R. writes: I am making some simple laboratory experiments and find alcohol very expensive for heating retorts, flasks, etc. Is there any method of constructing a lamp to burn kerosene, by which the soot and smell may be avoided? There is no gas in my house. Is there any other substance I can use, supposing kerosene is not available? A. Kerosene has not been successfully used for the purpose mentioned. The substitutes for alcohol are wood naphtha (crude methylic alcohol) and gas, the latter used with a Bunsen burner to secure perfect combustion.

(2) C. D. F. asks: 1. Why do opticians charge so much more for lenses (4 or 5 inches in diameter) of short focus (6 or 7 inches) than they do for lenses of same diameter and long focus? A. Because the more convex and shorter focus lenses are of necessity ground singly, whereas several of the longer focus lenses may be ground at one operation. 2. If the difference is in the processes of manufacture, why will not one process answer for both thick and thin lenses? A. Common convex lenses are secured to a convex tool or form and ground by moving over them with a gyratory motion a concave tool, the contact surfaces being charged with the grinding or polishing material. It is obvious that the form having the least convexity will contain the greatest number of lenses. 3. Why is crown instead of flint glass used for condensing lenses, when the refractive power of flint is greater? A. Crown glass of a uniform density is more easily made than flint glass of the same quality. 4. Is there a stereoscopic camera, which takes the views erect instead of reversing them, as in an ordinary instrument? We think not. 5. If not how are the prints made on one piece of paper, and mounted without cutting apart and changing the right for the left? A. The prints or the negative must be cut and transposed, or the views must be transposed in the camera. 6. Why is it necessary that there should be an odd number of cutting edges in the fluted countersink described on page 387, vol. 39? A. It insures a smooth cut. 7. What is used with mercury for tempering drills, which will make them tough enough to stand in drilling tempered steel? A. Nothing. After hardening draw the temper as near as possible to the cutting edge.

(3) C. L. S. asks: 1. Should the ratio between the teeth of different gears be the same as that between their diameters? A. Generally, yes. 2. What is the best work on cotton manufacturing; also on mill engineering? A. Address the book publishers who advertise in our columns for catalogues.

(4) C. L. U. writes: 1. I have 12 lbs. of zinc in three gravity batteries; the current is not strong enough. I would like to make a Bunsen battery; could I make one, using the above zinc, and how? A. The zincs should be recast in cylindrical form, with a slit in one side to permit of circulation. 2. What is the mean of "ohm" as used in telegraphy? A. The ohm is the unit of resistance to the passage of an electrical current; it is equivalent to a wire of pure copper one twentieth of an inch in diameter and 250 feet in length, or 330 feet of No. 9 iron wire.

(5) E. E. H. asks: How can I finish parlor brackets, made of walnut and cigar box lumber, cheaply, durably, quickly, and beautifully? A. Varnish the lumber before sawing, saw with thin boards between and on the sides of the lumber, and use a fine saw.

(6) S. G. B. asks: 1. Can insects and snakes hear? A. Yes. 2. How are knife blades tempered, so as not to warp? A. By plunging them straight down in the water in the process of hardening.

(7) M. L. A. asks how to drill a hole one half inch in diameter through the bottom of a large glass flask. It is intended for a home made electrical machine. A. A copper tube ½ inch in diameter pressed against the glass lightly and plentifully supplied with emery and water, and rotated by means of a lathe or drill stock, will accomplish it.

(8) C. E. O.—Directions for making induction coils are contained in the SCIENTIFIC AMERICAN SUPPLEMENT No. 160.

(9) E. K. asks: Who was Eastlake, and what are his principles of design in furniture? A. Eastlake is a living designer of furniture, etc., in London, Eng.; also art critic and author. His work on household art is published by Scribners. Clarence Cook's work, also published by Scribners, will explain Eastlakism.

(10) G. W. B. states that the shrinking and swelling of the wo en cases of telephones is one cause of derangement. We suggest soaking the wood in melted paraffine or giving them a coat or so of shellac varnish in the inside.

(11) F. S. writes: I am a surgical instrument maker, and in my work I have to bend steel rods, which must be polished before bending, as they have to be perfectly round when bent. The bending of the rods is done with a wooden mallet. 1. Is there anything that can be put on the steel or in the fire by which it might be kept from scaling? A. Apply to the steel before heating a thin paste of 75 parts of sifted wood ashes, and 25 parts of fat clay without sand, mixed with water. 2. Can you give me a receipt for soldering steel to malleable iron? A. Use silver solder.

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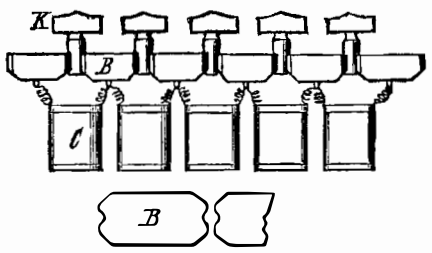
(12) H. A. D. writes: 1. How can I fix up a small, cheap electric light so as to exhibit it before a large class? A. The simple electric light apparatus described in SCIENTIFIC AMERICAN SUPPLEMENT No. 149 would probably answer your purpose. 2. How much battery power would I require? A. 6 or 8 Bunsen cells. 3. Would a machine 7x4 inches generate sufficient electricity for it? A. As we do not know what kind of machine you refer to we cannot say SUPPLEMENT No. 161 contains instructions for making a machine that will answer the purpose. 4. Should I use an induction coil? A. You may obtain beautiful effects by using an induction coil in connection with vacuum tubes, but a very brilliant light cannot be obtained in this way. 5. Have you given information as to how to make induction coils? I am getting up some experiments for the purpose of giving a free exhibition to school children. By answering the above, you will confer a favor on an amateur, and may thus stimulate young minds to look into facts for themselves. A. SCIENTIFIC AMERICAN SUPPLEMENT No. 160, will contain full instructions for making induction coils.

(13) H. C. and others.—The principle of the rheostat may be understood by referring to the engraving. Several coils, C, of measured resistance, are connected with brass blocks, B, which are fitted into



the top of the instrument. The first brass block is connected with one terminal of the first resistance coil; the second brass block is connected with the other terminal, and with one terminal of the second coil; the other terminal of the second coil is connected with the third brass block, and so on. The adjacent ends of the blocks are notched to receive the keys, K. Whenever one of the keys is inserted, the coil immediately below it is cut out of the circuit, and the current passes directly from one of the brass blocks to the other, through the key.

(14) J. M. asks how the wire should be wound on an electro-magnet. A. The manner of winding the wire on an electro-magnet is shown so clearly in the cuts as to require little explanation. Fig. 1 shows the two soft iron cores separated from the soft iron bar to which they are attached after being wound.

Fig. 1.

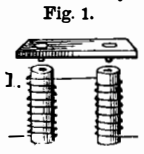


Fig. 2.

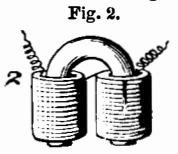
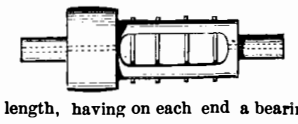


Fig. 2 shows the manner of connecting the spools of a U electro-magnet. If the iron core were straightened and the spools placed together, it would be seen that one spool is simply a continuation of the other.

(15) Maudie writes: I am a little girl eight years old. In a little book my papa got of you, called the SCIENTIFIC AMERICAN Reference Book, I found a rule for making soap bubbles, and as I like real well to blow soap bubbles, I got papa to get me the glycerin and I tried it just as the rule says, but I could not make any, they would not even form in the pipe. Papa says perhaps the printer made a mistake and that I might write to you about it. I have tried so many ways to make soap bubbles that papa calls me his little chemist and says I ought to have been a boy. The best way I have found is to put half an ounce of castile soap into a pint of distilled water. I have blown bubbles from this 4 inches through that would last 2 minutes, and I have blown them as large as 7 inches through. A. You probably used too much water or diluted glycerin. The receipt, which we have often tried with very satisfactory results, is given by Professor Josiah P. Cooke, as follows: "Procure a quart bottle of clear glass and some of the best white castile soap (or, still better, pure palm oil soap). Cut the soap (about 4 ounces) into thin shavings, and, having put them into the bottle, fill it up with distilled or rain water, and shake it well together. Repeat the shaking until you get a saturated solution of soap. If on standing, the solution settles perfectly clear, you are prepared for the next step; if not, pour off the liquid and add more water to the same shavings and shake as before. The second trial will hardly fail to give you a clear solution. Then add to two volumes of soap solution one volume of pure concentrated glycerin." "The New Chemistry," p. 29. Grand soap bubbles can be blown with this preparation.

(16) G. F. C. asks how to make a simple wire straightener? A. Such a tool is shown in the accompanying cut. It consists of a casting about 10



inches in length, having on each end a bearing which may be supported in suitable boxes. The pulley is a part of the casting, and is 3 inches in diameter and two inches wide. Four steel pins are inserted 1 inch apart and a little to one side of a central longitudinal line. A hole a little larger than the wire to be straightened is drilled axially through the bearing. The wire passes through the tool over and under the steel pins. It is well lubricated and is pulled through as the tool revolves.

(17) C. M. sends the following formula: To find the area of a circle, multiply the square of the diameter by 77, divide the product by 100, and add to the result 2 per cent of same (that is, increase the result by 2 per cent). Do you consider the above an easier rule than the usual one (r^2. [π]. 3·1416), the solution being identical? Your formula in SCIENTIFIC AMERICAN Reference Book brings the same result. A. In many cases the rule given by you would be simpler.

[OFFICIAL.

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

November 19, 1878,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

Acid, making acetic, A. Pirz 209,978, 209,979
Adding machine, M. Norgren 209,977
Animal trap, C. Isbell 210,040
Animal trap, S. H. Wiesedeppe 210,071
Azimuths, device for taking, W. Thomson 210,068
Bag tie and address holder, J. A. Burchard 210,004
Bag tag and fastener, H. Anderson 210,001
Bails, maker for pail, L. Williams 209,998
Bale tie, G. C. Clarke 209,958
Bark reducer, W. Chicken 210,095
Barrel maker, Hodgen & Yelton (r) 8,498
Bed bottom, spring, T. J. Pettit 210,145
Bed bottom, spring, E. Yeoman 210,000
Bed, camp, W. G. Richardson 210,148
Bedstead fastening, T. J. House 210,123
Bedstead, invalid, G. Iveson 210,126
Bedstead, wardrobe, D. D. Shupe 210,057
Bedsteads, folding leg for sofa, Schultes & Walter 210,156
Bench dog, C. Morrill 210,140
Bit brace, C. H. Amidon 210,075
Blackboard, folding, B. G. Luther 210,044
Blind, Venetian, E. B. Lake 210,129
Boat, outrigger, M. F. Davis 209,960
Boiler, sectional, A. W. Cram 210,013
Boiler, steam, Firmenich & Stiker (r) 8,494
Boiler and furnace regulator, J. A. Lakin 209,972
Boot and shoe sole and heel cutter, J. H. Busell. 210,006
Boot and shoe cleaner, G. F. Ziegler 210,072
Boot and shoe sole dresser, G. Danforth 210,103
Boot jack, F. T. Lessen 210,131
Boot and shoe lasting jack, E. J. E. Rollins 209,996
Bottle stopper, J., Sr., & A. Doulceron, Jr. 210,105
Bracelet, L. Heckmann 210,119
Bracket rod, W. S. Blake 210,084
Brake, automatic sleigh, H. Hunt 210,039
Brake, car, C. H. Nye 210,050
Brake, automatic wagon, J. G. Hart 210,030
Brake, wagon, I. S. Wright 209,999
Bran scourer, W. Harris 210,029
Brush, F. W. Gesswein 209,967
Brush, C. H. Stratton 210,166
Button, Empson & Brant 209,965
Button, collar and sleeve, W. P. Dolloff 210,017
Button, collar and sleeve, G. B. Fittz 210,110
Calendar, C. W. Bryan (r) 8,492
Canister, G. Lillibridge (r) 8,500
Car coupling, S. A. Haydock 210,117
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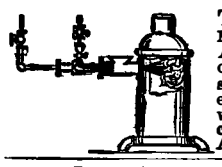

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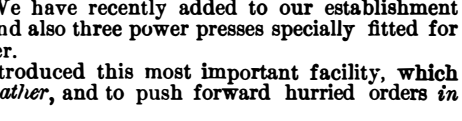

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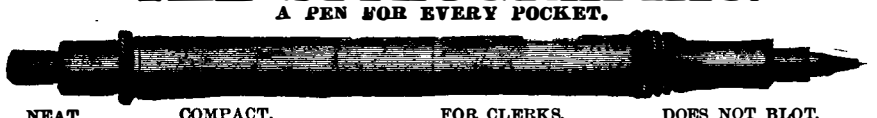

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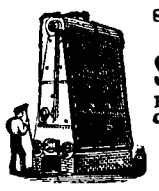
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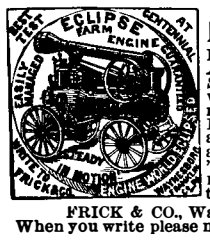

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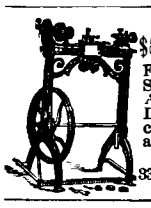
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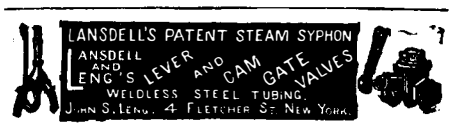
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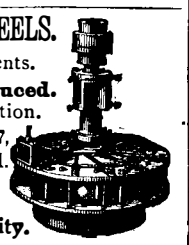

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